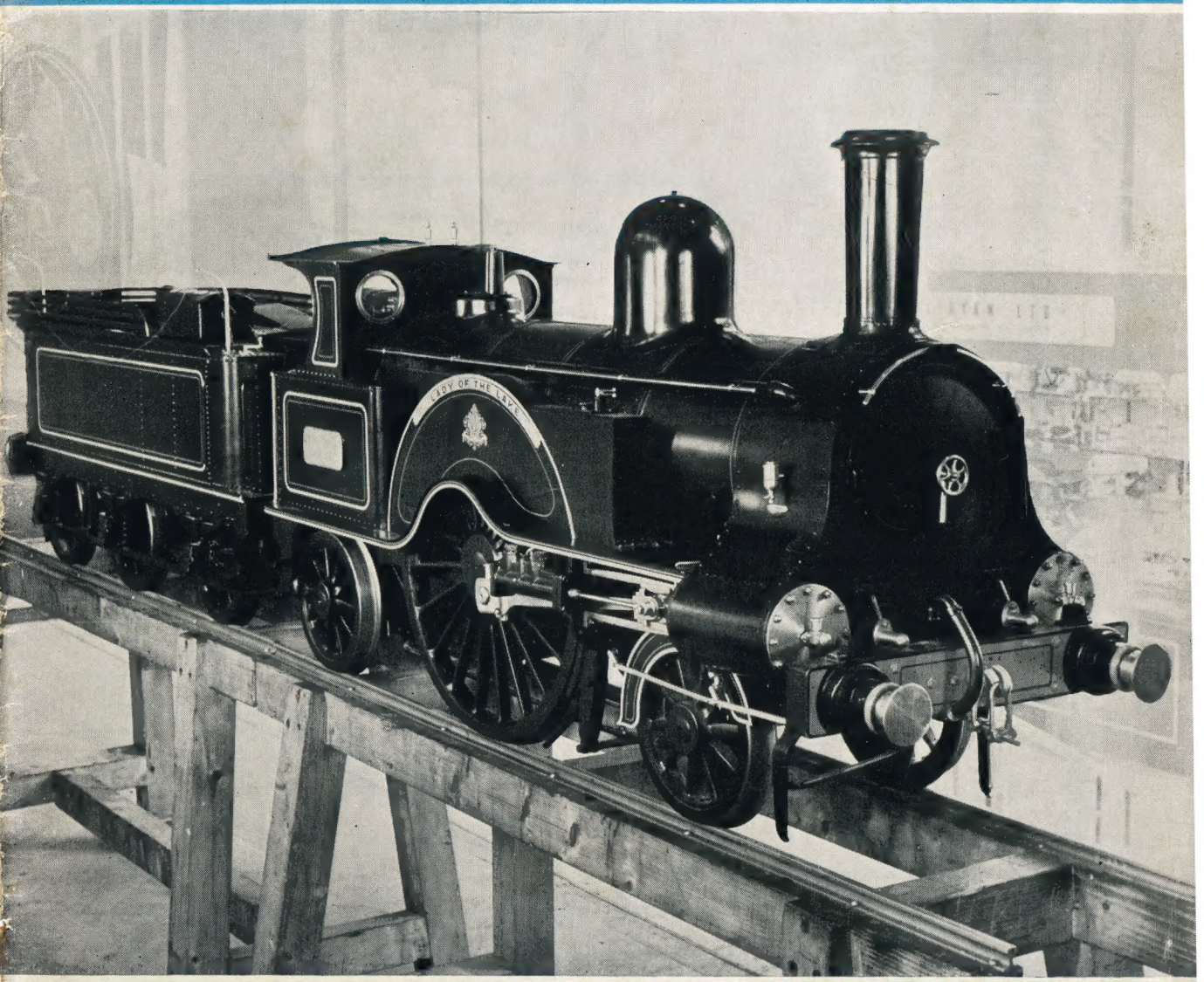
# THE MODEL ENGINEER

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• THE CONNAUGHT FORMULA I RACING CAR — AN EXCELLENT
SUBJECT FOR MODELLING • A DOUBLE-PURPOSE SINE BAR

FEBRUARY 10th 1955
Vol. 112 No. 2803

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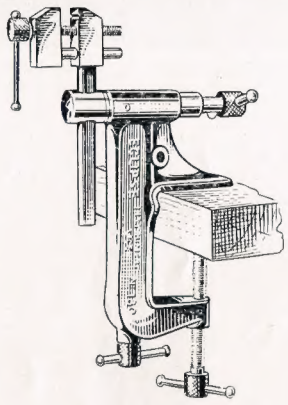

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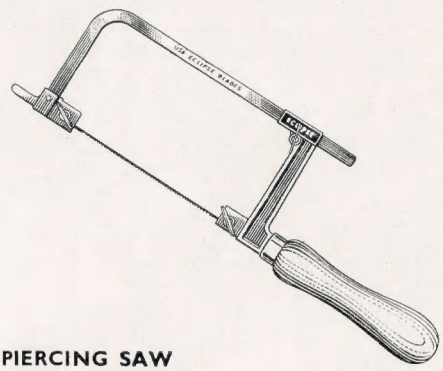

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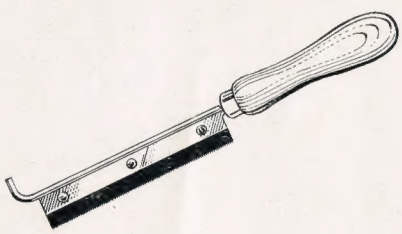

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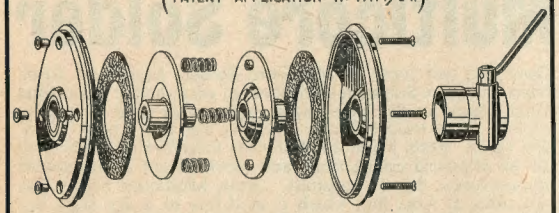

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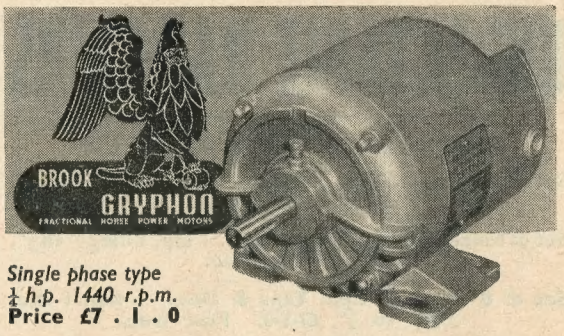


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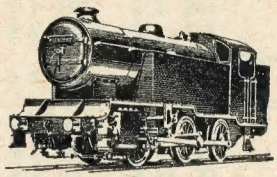

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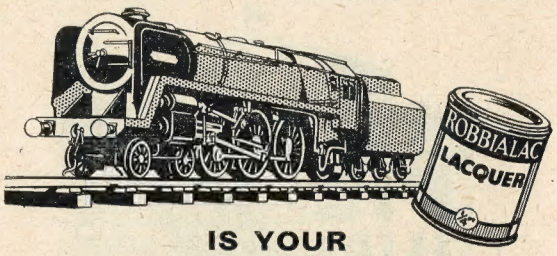


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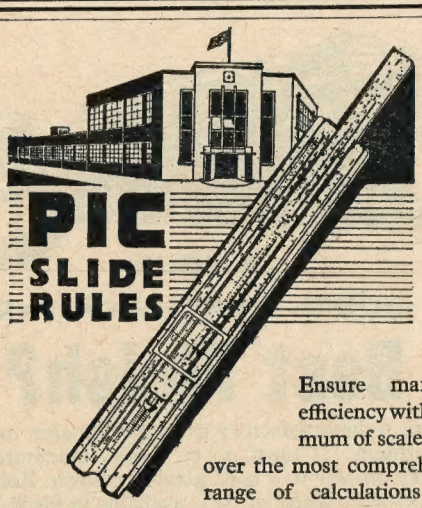


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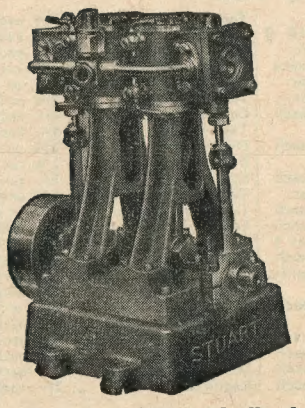

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# THE MODEL ENGINEER

EVERY THURSDAY
Volume 112 - No. 2803
FEBRUARY 10th - 1955

ESTABLISHED 1898

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### OUR COVER PICTURE

The 2-in. scale L.N.W.R. 2-2-2 type locomotive *Lady of the Lake*, built by Mr. H. C. Powell, of Crewe, is one of the best of its kind in existence. It is, of course, not only made very closely in accordance with full-size practice, but in external appearance, it leaves very little to be desired. This is in spite of the fact that several departures from exact scale details had to be made in order to ensure that the engine should be as satisfactory as possible as a working job when in steam on a track. A 2-in. scale locomotive could scarcely be built in the average home workshop; but where, as in this case and others that we know of, more than ordinary equipment is available, such an engine is worth building.

# SMOKE RINGS

### Railway Electrification

OUR RECENT comment about the thermal efficiency of railway electrification being "no better than with steam traction when coal is the source of power" has provoked several readers to write to point out that the efficiencies of modern generating stations and electric locomotives are in the order of 25 per cent. and 90 per cent., respectively. We do not doubt these figures, and certainly do not dispute them; but we contend that they do not reveal the whole truth. The operative words in our comment are: "When coal is the source of power," and we think this rather modifies the picture. According to the latest information that is available to us, and published in 1951, only 6 per cent. of the energy available in the coal ever reaches the conductors from which the locomotives obtain their supplies of electricity; the motors and internal friction account for further loss, and only about 4 per cent. is left as drawbar horsepower.

A complete analysis of the losses can be stated thus: of 100 heat units released from the coal in the boiler furnaces at the power-house, 68 are lost in the cooling towers, condensing exhaust steam; 22 more go straight out of the power-house chimneys; 10 go to the turbo-generators which, in themselves, lose 2; transmitting the current from the generator to the transformer accounts for another 1; the transformer's job of changing the current characteristics requires ½, which leaves 6½ to go forward from the transformer to the traction motor; this costs another ½, after which the motor contrives to lose a further 1½ and the internal friction of the locomotive absorbs the final ½, leaving only 4 to be returned as useful work at the rails as tractive effort or drawbar horsepower.

It is clear from this that if the boiler-house losses at the generating station were eliminated, there would be a very substantial economy; and this is exactly the advantage which the electric railways of Switzerland and France enjoy. It is also clear that, in themselves, the turbo-generators, transformers, transmission lines and traction motors are each very highly efficient, but are utterly incapable of passing on the benefit of that efficiency.

For a steam locomotive the analysis is: for every 100 heat units liberated from the coal in the firebox, 55 are blown out of the chimney by the exhaust; 36 are lost through radiation and incomplete combustion; 2 are wasted overcoming engine friction, leaving 7 to provide useful tractive power.

### Technical Films

AT THE invitation of Messrs. Shell-Mex & B.P. Ltd., we recently had the pleasure of attending a private exhibition of technical films, including one which we regard as specially interesting to model engineers, namely, "The Cornish Engine." It deals not only with this particular type of engine but also the early development of steam engines generally, with reference to the work of Papin, Savery, Newcomen, Watt, and Trevithick.

The Cornish type of beam engine, which was the first to exploit pressures considerably above atmospheric, in addition to sub-atmospheric pressures produced by Watt's condenser, paved the way for higher efficiency and economy than ever previously obtained; it was the means of reclaiming otherwise unworkable mines, draining the Netherlands fens, and also saving the Severn tunnel, the success of which was seriously threatened by an unexpected subterranean spring. A few of these venerable engines are still at work after well over a hundred years of service, but they are rapidly becoming extinct, and this film will do much to preserve their memory.

Also included in the programme was a magazine of "shorts," on various technical topics, and one showing how a gas turbine works, thereby going to the other extreme in dealing with the most modern form of motive power. In common with all films produced by the Shell Film Unit, the photography was excellent and the presentation beyond criticism. Arrangements for the loan of Shell films, most of which are available in sub-standard (16 mm.) size, for sound projectors only, can be made through the Petroleum Films Bureau, 25, New Bond Street, London, W.1.

# The Beam Engines at Littlemore

By Ian Bradley

THE disposition of the engines in the building varies somewhat from the arrangements at Crofton. At Littlemore there is no middle floor; the tops of the cylinders are approached from a gallery over the door leading to the boiler house. A stone stairway leads to this gallery from the floor of the engine room and is extended upwards to the top floor so that access to the beams may be obtained. These points will, I hope, be clear from the diagrammatic drawings of the installation.

I should, perhaps, offer some explanation about these drawings. Some hurried measurements, taken during one of several visits to the plant, were used to scale the photographs illustrating this article. From all this information—or perhaps in spite of it—the two diagrammatic drawings were prepared. As may well be imagined, it became necessary to compromise on many of the dimensions. It was also necessary to make the drawings fit into the paper; this in turn involved taking liberties with architectural and other details. Nevertheless, despite these difficulties, the diagrams portray the layout of the plant with reasonable accuracy, though no claim is made that they are dimensionally correct.

As at Crofton, winches are provided on the top floor to enable the beams and motion to be overhauled when necessary. However, whereas at Crofton there is a winch at each end of each beam, at Littlemore only two winches are employed; but the roof beams are liberally provided with eyes set at strategic points to accommodate blocks for handling purposes.

The pumps are of the bucket type with cylinders some 15 ft. long and a piston stroke of 3 ft. Each pump is driven directly from the engine beam and has an output of 150 gallons per stroke. The upper ends of the pistons, as seen from the floor of the engine room, are of ram form, as this enables a single adjustable gland to be used at the top of the pump cylinder. Close-fitting pistons provided with bronze piston-rings are attached to the bottom of the rams, and these pistons house the pump delivery valves consisting of a pair of concentric cast-iron rings with 1 in. thick rubber facings.

The suction-valves situated at the bottom of the pump cylinder are identical with those in the piston. In fact, the valve body is one of the pistons fitted into place without its rings.

Despite careful filtering, a piece of wood or some other foreign body occasionally becomes stuck between one of the valves and its seat. Normally, the obstruction clears itself, but I gather there have been occasions when it has been necessary to dismantle the pumps in order to get rid of the trouble.

The pumps work against a head of 100 ft. This corresponds to a pressure of approximately 45 p.s.i. in the rising main. In addition to the main force pump, as the makers' drawing describes this component, the engine has the three pumps usually associated with beam engines; a pump for supplying cold water to the condenser, the condenser air pump, and finally, a boiler feed pump. The location of these pumps can be seen in the general arrangement drawing and also in the plan view of the engine room. The cold water pump draws its supplies direct from the river Thames, and the boiler feed pumps on each engine are supplied with warm water from the hot well.

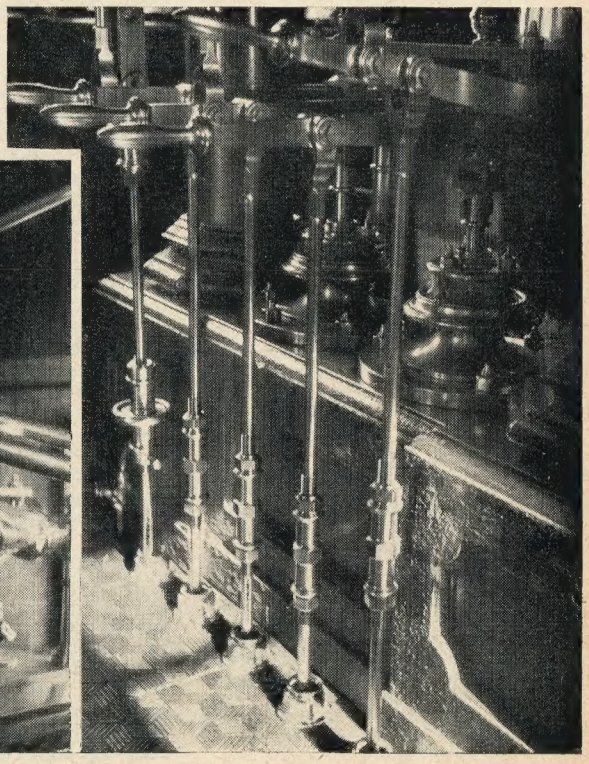
The boilers were made by Messrs. Tinker, Shenton & Co. of Hyde Boiler Works, nr. Manchester. They are made of the best Lowmoor iron and are 24 ft. long by 6 ft. diameter. There are four of these boilers, each connected to a common steam reservoir running the length of the boiler room. This reservoir is necessary because the width of the boiler is comparatively small, and when the water in the boiler is standing at the correct level, the steam space is insuffi-

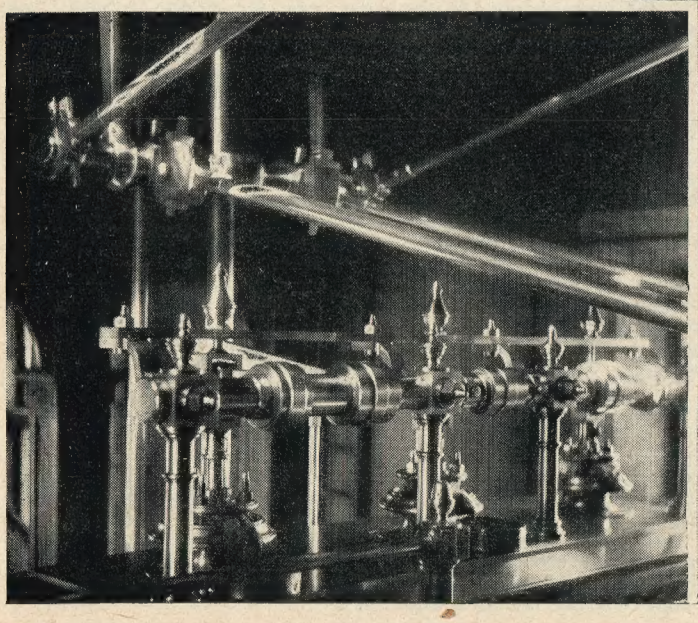
(*Continued on page* 151)

*Continued from page* 139, *February* 3, 1955.

**Right: Lower valve chest**

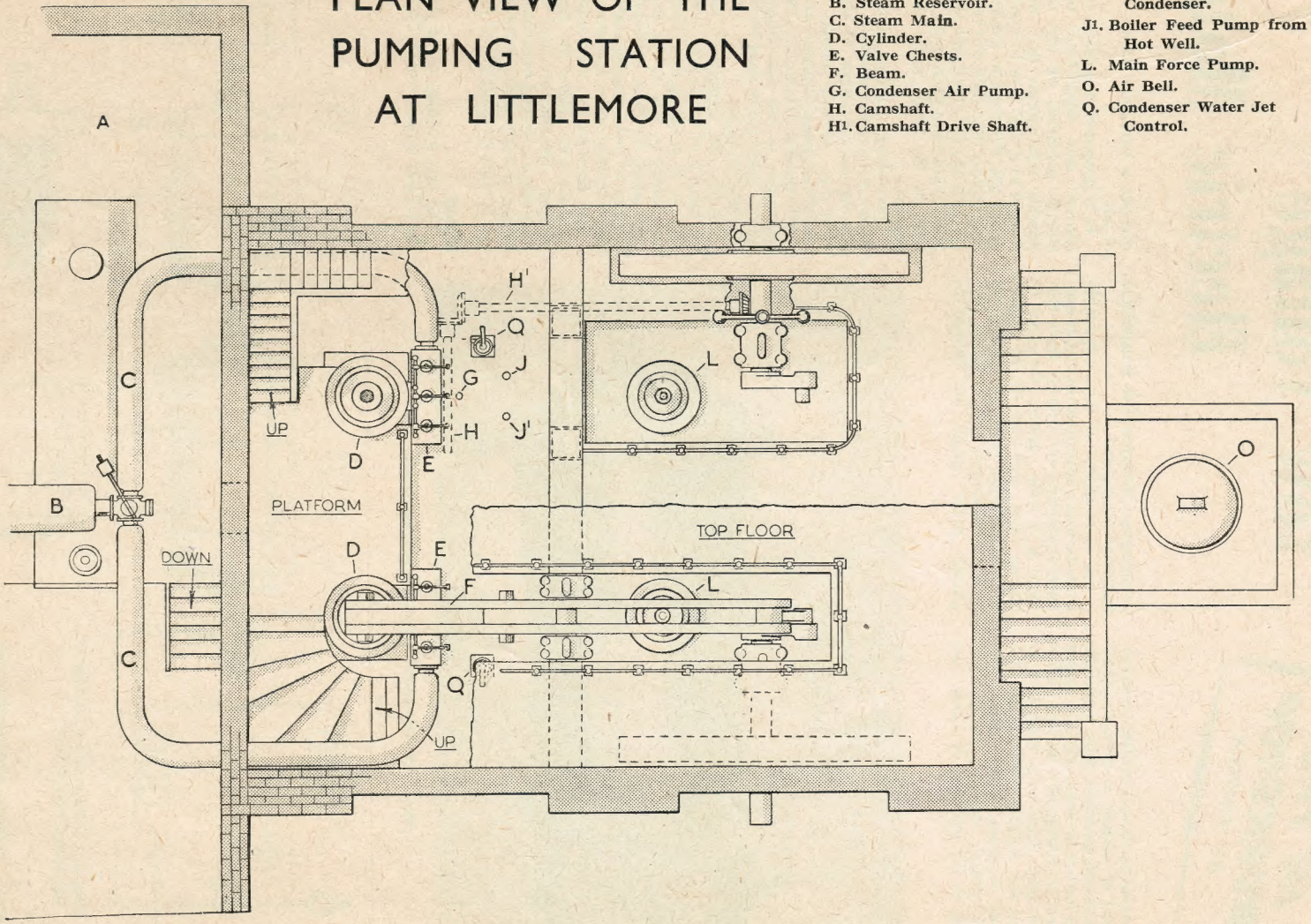
**Below: The upper valve gear and part of the parallel motion**





# PLAN VIEW OF THE PUMPING STATION AT LITTLEMORE

A. Boiler Room.
B. Steam Reservoir.
C. Steam Main.
D. Cylinder.
E. Valve Chests.
F. Beam.
G. Condenser Air Pump.
H. Camshaft.
H1. Camshaft Drive Shaft.
J. Cold Water Pump to Condenser.
J1. Boiler Feed Pump from Hot Well.
L. Main Force Pump.
O. Air Bell.
Q. Condenser Water Jet Control.



IN THE WORKSHOP
BY DUPLEX

# Low Voltage Electric Motors

IN the past we have described the application of certain ex-service electric motors to various duties in the workshop and we have now been asked to gather together the information on this subject that has been dealt with, from time to time, in our articles. To do so will, in some measure, mean going over ground already covered in previous articles; in the interests of clarity and completeness, however, this is inevitable and must be excused.

An examination of lists obtainable from the many advertisers of ex-Government equipment will quickly show that there is a wide variety of motors to choose from; but there is, of course, little information as to the capabilities of these machines, and would-be purchasers must decide for themselves whether a particular motor is suitable or not.

It is proposed, therefore, by recapitulating and amplifying the notes already published on this subject, to provide information that will enable readers to decide how to make the best use of any motors now available. The only motors described will be those that we ourselves have used, and the information contained in these notes will, therefore, be the result solely of practical experience.

Low-voltage motors used by the British Service Departments are generally wound for either 12 volts or 24 volts d.c., whereas similar American military equipment appears to have been standardised at 27 volts d.c.; these figures also apply to the low-voltage side of various dynamotors used by all Services for radio purposes.

Clearly, the quality of the various machines is of the highest class, and far superior to anything that industry could now afford to put on the market; the price asked for these machines is but a fraction of their original cost, and they are wonderful value for money.

For convenience, the equipment will be dealt with under the headings of Motors, Dynamotors and Magslips; these last are special machines, designed for use with alternating current, and they can be used as small power motors.

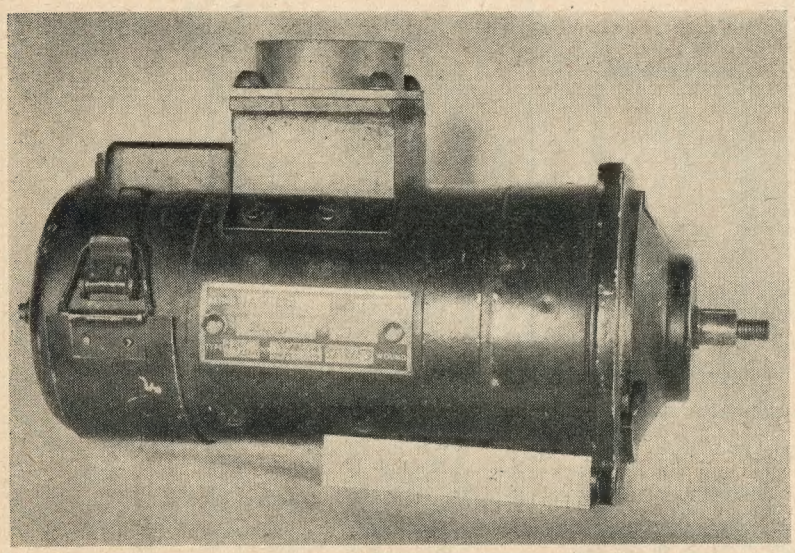


**Fig. 1. Series-wound 1/3rd h.p. 24-volt motor**

## Motors

The first machine to be described is the 1/3rd h.p. series—wound 24-volt motor

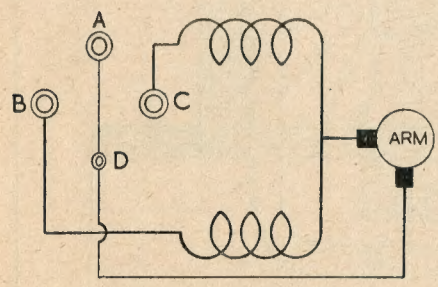
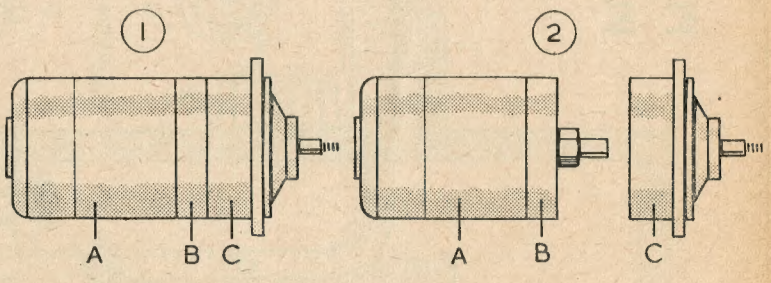
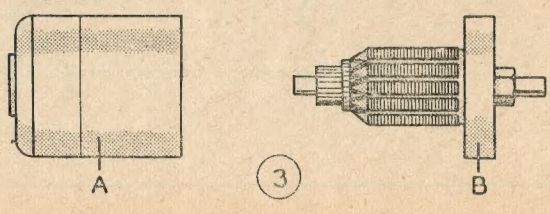



**Fig. 2. Diagram of internal connections of the series-wound motor**




**Right: Fig. 3. Diagram of mechanical construction of motor**

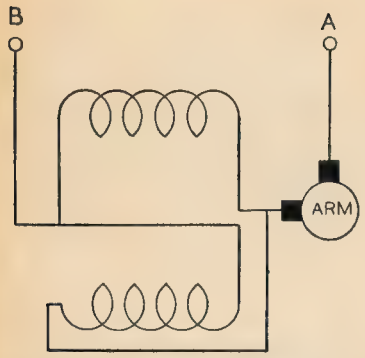



**Fig. 3 A. The modified electrical connections of the 1/3rd h.p. motor**

It has already been said that these particular motors have two opposing field windings to enable them to be easily reversed. If these windings are connected together in parallel, it will be found that the time rating of the machines is materially increased; moreover, the torque will be improved, and this is specially valuable where the motor is run at a lower voltage than that shown on the rating plate. The modified electrical connections are shown in the diagram, Fig. 3A.

We have used this type of motor for a number of purposes, supplying the machines with alternating current from a transformer run from the mains, and giving an output of 21 amps at 14 volts a.c. or 20 volts a.c.

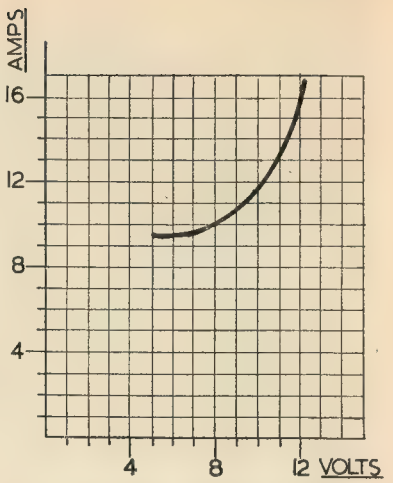



**Fig. 6. Graph, showing current taken by the motor**

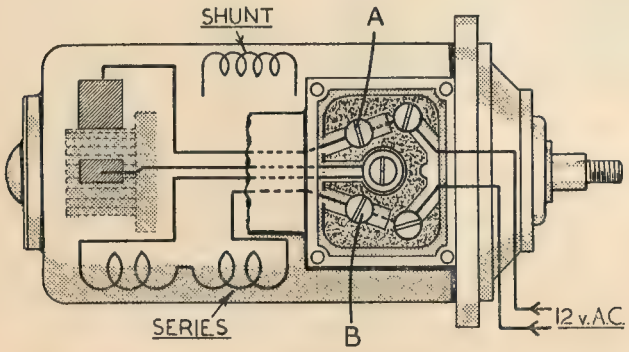



**Fig. 5. Modified connections for the alternative type of motor**

illustrated in Fig. 1. This machine, bearing Air Ministry Catalogue No. 3U/2364, has an intermittent rating of 1/3 h.p. at 4,000 r.p.m., and takes a current of 21 amp. at full load. The motor is provided with two opposing field windings for easy reversal, connected as shown in the diagram Fig. 2, and brought out to four contact pins, fixed to a terminal block, suitable for connecting to a standard Plessy plug. In all the motors we have used, the four pins are discarded and are replaced by alternative terminals or by switchgear. However, those readers who do not wish to go to the trouble of making new terminals can readily provide contact sleeves to slip over the original pins, using either *A* and *C* or *A* and *B* according to the direction of rotation required.

A simple friction clutch is housed in the removable housing *C*, seen at the front of the motor in the diagram, Fig. 3. If this housing is removed, the motor spindle is exposed. The spindle is provided with a Simmonds nut that may be removed, so that the spindle can be turned down to $\frac{1}{4}$ in. dia. To do this, the armature should be removed and mounted between centres in the lathe. After the brushes have been lifted, and the bearing end-cap removed, the armature can be withdrawn with one end-plate *B* in position, as seen in the diagram.

These motors, since they are series-wound, run well on alternating current and develop ample power at either 14 volts or 20 volts. These machines are akin to starter motors fitted to automobiles and have only a few turns of small resistance in the field windings, so that these have but small self-inductance. For this reason, the performance of these machines on alternating current, for a given voltage, is almost the same as it would be on direct current. It must be remembered, however, that the pole-pieces of the motors are solid and not laminated. The heating effect caused by the eddy currents in the pole-pieces will effectively prevent the motors being used for any continuous duty; however, we are, at the moment, engaged in some experiments designed to overcome this

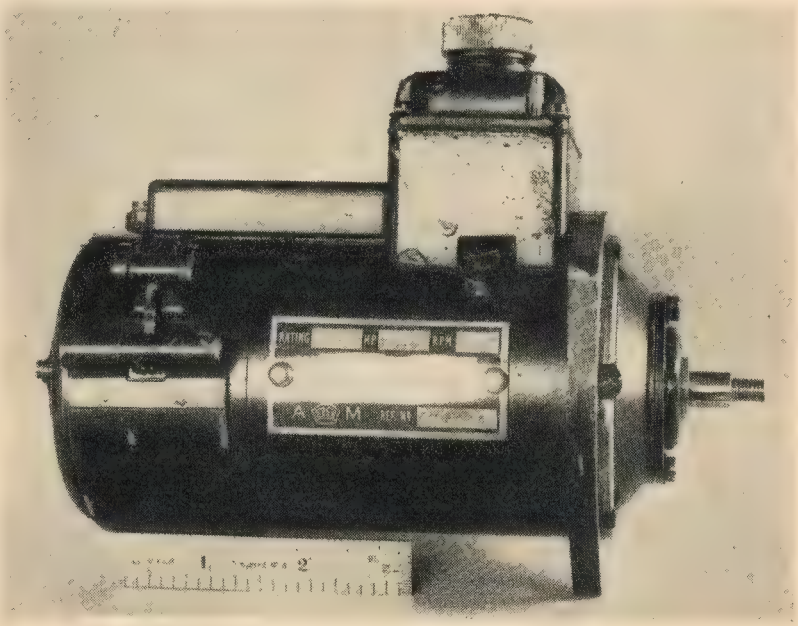


**Fig. 4. An alternative type of 1/3rd h.p. motor**

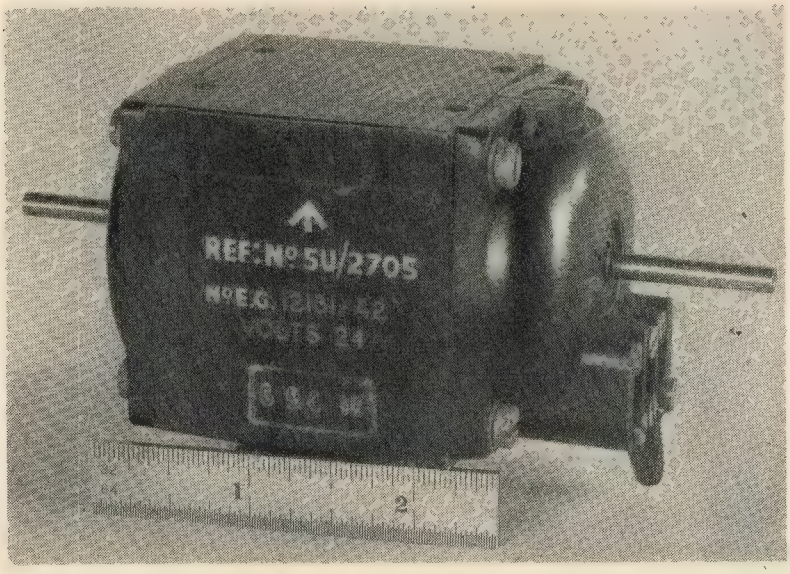



Fig. 7. Miniature 24-volt shunt wound motor

difficulty, and hope to submit the results if they are successful.

Up to the moment, we have used these machines for three different purposes, the details of which are given in the table:

The transformer was purchased from Mr. K. McGrath, 244 Marton Road, Middlesbrough, whilst the motors came from Mr. K. R. Whiston of 8 Watford Bridge Rd., New Mills, Near Stockport.

The motor illustrated in Fig. 4 is generally similar to the 1/3 h.p. machine previously described. In this instance, however, the preloaded clutch is omitted; this makes the mechanical adaption of the motor somewhat simpler. The motor is a 4-pole machine with windings compounded, and with the series and shunt field windings on separate pairs of poles.

As with the first motor, the brushes are set at 90 deg. In order to adapt the machine for alternating current, the wiring of the motor needs to be modified. Accordingly, the cover of the terminal box, together with the box itself, must be removed, and the wiring thus exposed, rearranged and reconnected to conform with the diagram, Fig. 5. In this way, the motor will be series-wound and will run on alternating current.

The speed of the motor, running light, is high; in fact, considerably higher than the 3,500 r.p.m. shown on the rating plate. If additionally, however, the shunt field windings are connected across the line wires, that is to the terminals *A* and *B* in the diagram, it will be found that the motor speed is reduced and will be held constant at some 3,500-4,000 r.p.m. Under these conditions the power output from the motor is low; for some purposes, however, this may not be undesirable. For many applications, 12 volts a.c. will be found sufficient; at this voltage, and with the shunt field disconnected, the current taken by the machine is 16 amps, as will be seen from the graph, Fig. 6.

| Purpose | Transformer Volts | Current | Published |
|---|---|---|---|
| Hand Drill ... ... | 14 volts or 20 volts according to spindle speed ... ... ... | 16 amps | Aug. 19/54. |
| Compressor Drive ... | 20 volts ... ... | 20 amps | Sept. 30/54 and onwards. |
| Milling Attachment ... | 14 volts ... ... | 12 amps | Sept. 16/54. |

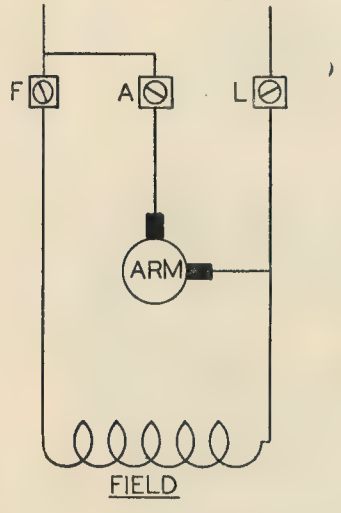



Fig. 8A. Connections of the shunt wound motor

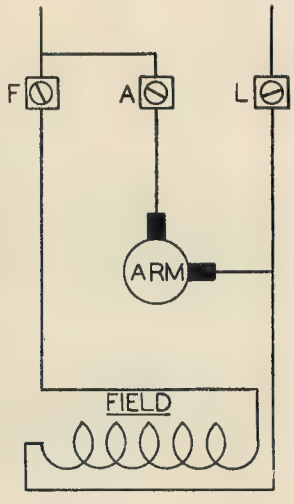



Fig. 8B. Electrical connections for reversing the motor

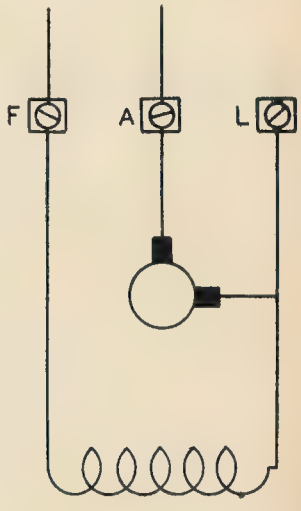



Fig. 9. Electrical connections necessary when running the motor as a series-wound machine

**Adjusting the Brush Position**

The motor is provided with means of adjusting the brush position, and this adjustment should be tested after the re-connecting has been carried out, moving the brushes in the direction of the armature's rotation. This will increase the speed of the machine.

Before the motor is run, the bearing covers should be removed and the thick lubricant used to pack the bearings should be diluted with thin oil.

The motor, Air Ministry Ref. No. 5U/4065, may be obtained from Mr. K. R. Whiston.

The next motor to be described is the miniature 24-volt shunt-wound motor illustrated in Fig. 7. As will be seen, the machine has an Air Ministry catalogue number—5U/2705—and is provided with moulded end-plates to carry the ball-bearings that are seated in cast-iron sleeves, moulded in position. The carcase of the machine is built up from laminations shaped to form the four poles for the field windings. The brushes, set at 90 deg. in one end-plate, are held in place by split-pins passing through brass plugs fixed to the ends of the brush springs. The machine is readily dismantled, if the brushes are first withdrawn, and the screws securing the opposite end-plate are removed. A light tap on the driving spindle will then allow the armature to come away. This procedure may be necessary if the direction of rotation has to be reversed, for, somewhat unfortunately, the internal connections have not all been brought out to independent terminals. These connections are as shown in the diagram, Fig. 8A, and it will be obvious that the machine can be reversed if the field winding connections are changed end for end, as seen in Fig. 8B.

We are using this motor as a shunt-wound machine to drive a self-act for the lathe cross-slide. The motor is fed with direct current at some 16-18 volts from a metal rectifier supplied from the transformer mentioned in connection with the previous motor. When the self-act is in operation, current consumption is about an ampere. This may seem to be a ridiculously low figure, but it should be mentioned that the special combined worm and epicyclic gear box made for the equipment has a reduction 1,200–1.

A further use that has been made of this particular motor is for driving an inventor's demonstration model, and for this purpose, it was necessary to run the motor from the a.c. mains. The machine was, therefore, made series-wound by simply connecting the mains to the two motor terminals marked *F* and *A*, as seen in the diagram, Fig. 9. A 400-ohm resistance, consisting of a length of radio set feed cable, was used for connecting the motor to the mains.

It should be noted that this type of motor is not suitable for running on a.c. as a shunt machine, owing to the high impedance of the field windings.

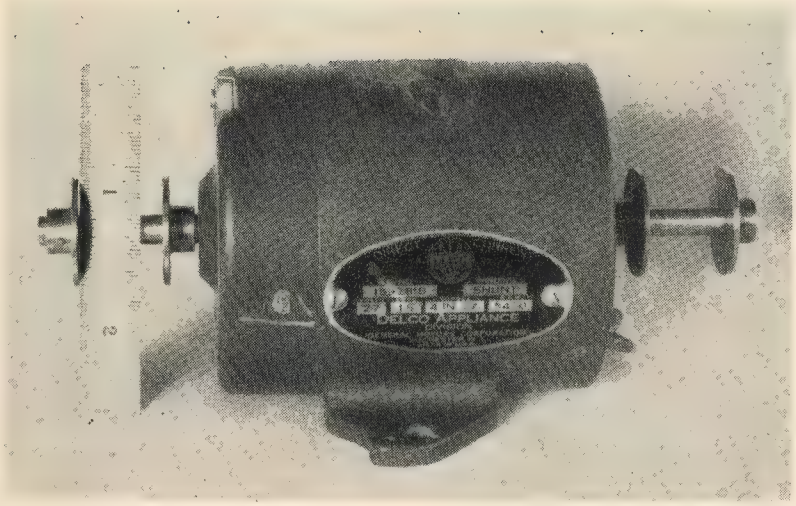



**Fig. 10. A motor of similar type, but for 27-volts d.c., made in America**

These windings consist of many turns of fine wire, and have a resistance of some 125 ohms; consequently, the self-induction or inductance of the windings has a high value. This re-acts against the voltage across the field windings, and chokes down the current passing through them. Raising the voltage to, say, 40 volts would help to offset this effect, but it is unlikely that the low-resistance armature would long survive this excess voltage unless protected by a separate resistance. Moreover, there is the added danger of an excess of sparking at the brushes.

The motor illustrated in Fig. 10 is the American counterpart fitted to similar service apparatus, that is to say, the bomb sight computer. This motor, made by Delco, is shunt-wound, and runs at a somewhat higher speed than the square-shaped machine previously described. The spindle is fitted with a pair of flanges at each end, and these may be removed by withdrawing the pins that secure them to the spindle.

The $\frac{3}{16}$ in. diameter spindle of this machine is 1/32 in. larger than the English motor; this is an advantage when fitting pulleys or pinions to the spindle.

*(To be continued)*

# The Beam Engines at Littlemore

(*Continued from page* 146)

cient. Each boiler has its own safety-valve and is fitted with the usual instruments; it is connected to the main steam reservoir by means of an independent valve. As may be seen in the plan view of the plant, the reservoir itself has a safety-valve incorporated, which forms a part of the branch of the steam main.

In addition to the boiler feed pumps that are driven directly from the beam engines, there is an independent steam-driven pump located in the boiler room itself.

**Engine Details**

As readers will doubtless gather from the illlusatrations, there is a wealth of ornamental detail in these engines. The ornamentation is not overdone in any way; in fact, the whole effect is most satisfactory and a splendid example of the fine work that was done in the old days. Outstanding specimens are the piston-rod links, the valve-chests and much of the valve-gear itself.

Since many of the engine parts are made of wrought-iron, it is inevitable that signs of fatigue are beginning to appear. It has already been necessary to make a new steel connecting-rod little-end shoe for one engine and to drill the connecting-rod eye in the other engine so that high tensile-steel bolts could be used to close a fracture that had become apparent. Probably the most interesting matter for the student of engineering is the method used for operating the valves. There are no plug-rods at Littlemore, for the valves are lifted by means of a camshaft running beneath the valve-chests. The cams are provided with followers and so move push-rods in much the same way as do similar parts in a petrol or gas engine. The camshaft is driven from the engine crankshaft through bevel-gears by means of an intermediate shaft running longitudinally under the floor of the engine room and supported where necessary by plummer-blocks.

# TWIN SISTERS

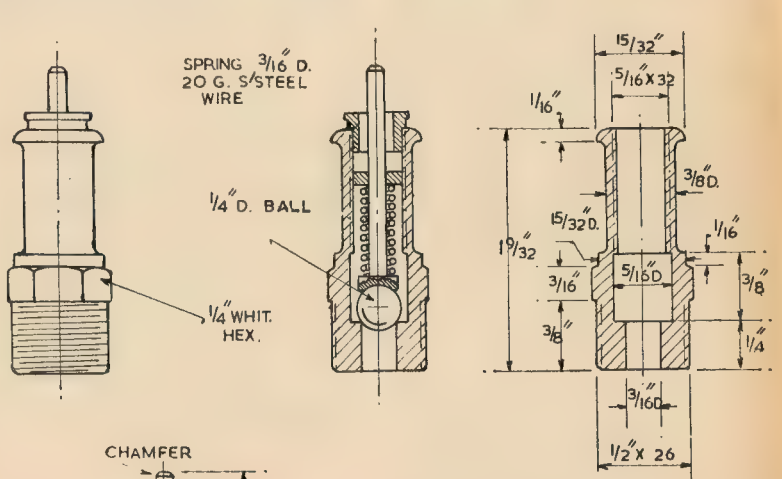
**By J. I. Austen-Walton**

THE next group of fittings comprises the safety-valves, water manifold fitting, combined blast nozzle, plus blower unit and the axle pump bypass valve.

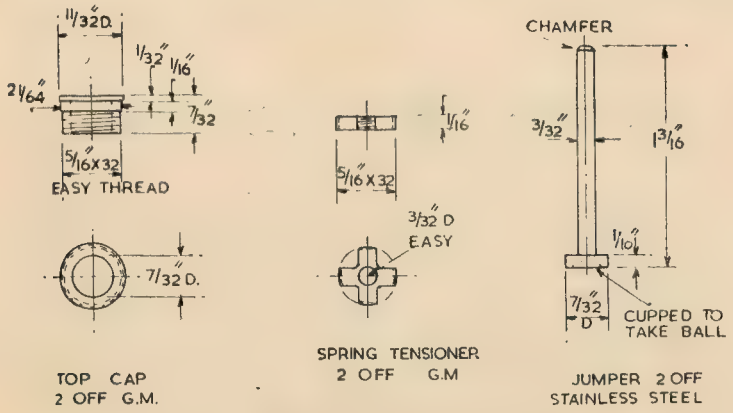
The safety-valves were a problem. I wished to keep these near scale size, yet capable of "shedding the steam pressure load" quickly, with a clean decisive action. The limiting factor, as it always is, was the size of ball and the diameter of the seating to suit. A safety-valve that possesses restrictive passengers *past* the ball is a potential danger, and this was overcome by boring out the adjustment thread inside the body in the region of the ball lifting area. Early considerations of the problem caused me to fit safety-valve bushes large enough to house a really big valve, and there were many explorations with pencil and paper before this highly efficient little valve came into being. The boiler has proved itself to be a prodigious steamer, yet it yields surplus pressure very quickly—on one valve as a rule, due to slight spring variations that I have as yet been too lazy to alter. The degree of actual lift required in a ball-valve, is surprisingly little, and it is excessive lift that is usually responsible for erratic action, failure to close readily, and excessive wear of the seating. The next point of restriction is invariably where the spring retention and adjustment fitting embrace the "jumper." The ideal state is where the free area of escape equals the seating area—or a little more, if it comes to that.

My adjustment rings (or spring tensioners) are always made as thin as possible and with as much cut-away as can be arranged. The thickness of this part is important, for a narrow opening offers less restricton than a wide one of the same area. For example, a thin diaphragm with a $\frac{1}{16}$ in. hole in it will pass more steam than a length of pipe of $\frac{1}{16}$ in. bore, under equal pressure conditions. With safety-valves, there is a simple, visual way of detecting back pressure in the fitting, for where the final release is through a tensioner such as most of us use, the issuing steam, when the boiler is blowing off really hard, will appear as clear jets coming from as many openings or slots as are provided. If the steam appears in a milder and more general outflow, it indicates that back pressure is of little practical account.

Finally, I prefer to keep the adjustment arrangements inside and out of sight, so that valve settings are not characterised by odd lengths of bare thread sticking out in the breeze. There is not much that I need tell you about the making of the valves themselves, and the drawings should explain everything. I do suggest that when the valves are fitted to the boiler, that the main threads be left fairly "snug" so that they may be screwed in with the necessary jointing paste and left standing out at the required height. It should not be necessary to screw them in to the limit of the thread, and reference to the cover plate (described some time ago) shows that it is intended to sit on the two short collars left just above the hexagon of the valve. Adjustments should be made so that the two valves are of equal height above the boiler, yet still allow the cover plate to make contact with the firebox lagging. Sounds a bit fussy, perhaps, but nothing looks worse than a couple of valves, one pointing one way, and one the other, to say nothing of unequal height. The cover plate also conceals a couple of inelegant hexagons if nothing else! Also, beware of too much spring. This should not be *close wound*, otherwise you may, inadvertently, collapse the entire free movement before reaching the desired blow-off tension.




**Safety-valve (2 off, G.M.)**




**Parts of safety-valve**

### Water Manifold Fitting

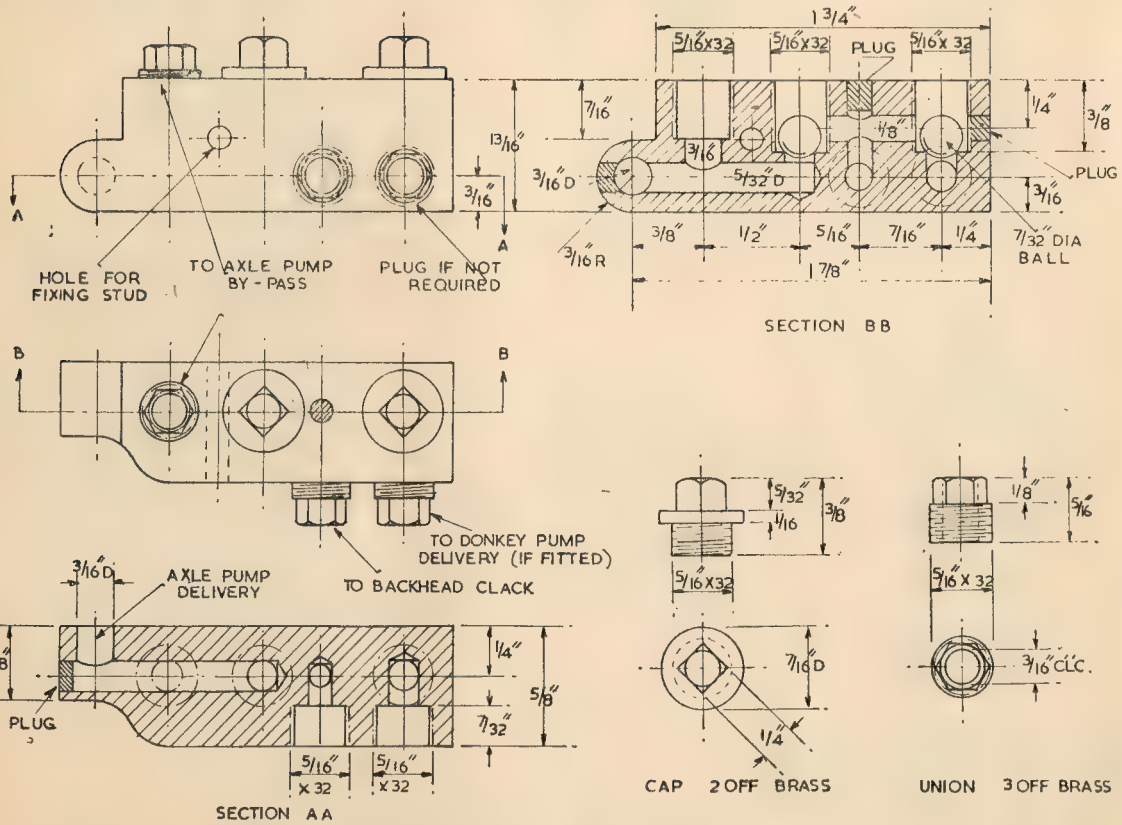
This is, in all probability, something that is new to readers, but its purpose is far from obscure. The same function is served by a diabolical collection of smaller fittings dispersed about the entire after part of the cab. The use of such a fitting disposes of much of the wandering pipework that often disfigures rather than embellishes the cab interior. Its object is to receive, at one

*Continued from page 53, January 13, 1955.*

central point, feed-water from the axle-driven pump and one auxiliary (donkey pump or hand pump, if you can find anywhere to fit it). Where a donkey pump is installed, you will find a separate bypass valve invaluable, for reasons I have already given in a previous issue. The manifold provides all this, and a simple plug blanks off the unwanted connection if you are not yet ready to fit a donkey pump.

The various connections are marked shown on this same drawing. The valve is fitted *inside* the side tank in a position that will allow the spindle to come out at a location exactly corresponding to its sister valve on the other side tank (water tank drain valve). The connection from the bypass valve to the manifold entails the use of a small elbow (not shown on the drawing) so that the short pipe may make its turn into the back of the valve. Just above this connection will be found a tapped separate by-pass valve on the front bunker face, and which has not yet been described.

What else is derived from the use of a main water fitting? Much; I so arranged my pipework that when cleaning or servicing the engine, the entire pipe system can be disconnected and lifted out in a single "harness," and those who have suffered the agonies of pipe cleaning *in situ* will appreciate what this means.




**Water delivery manifold (Body, 1 off, G.M.)**

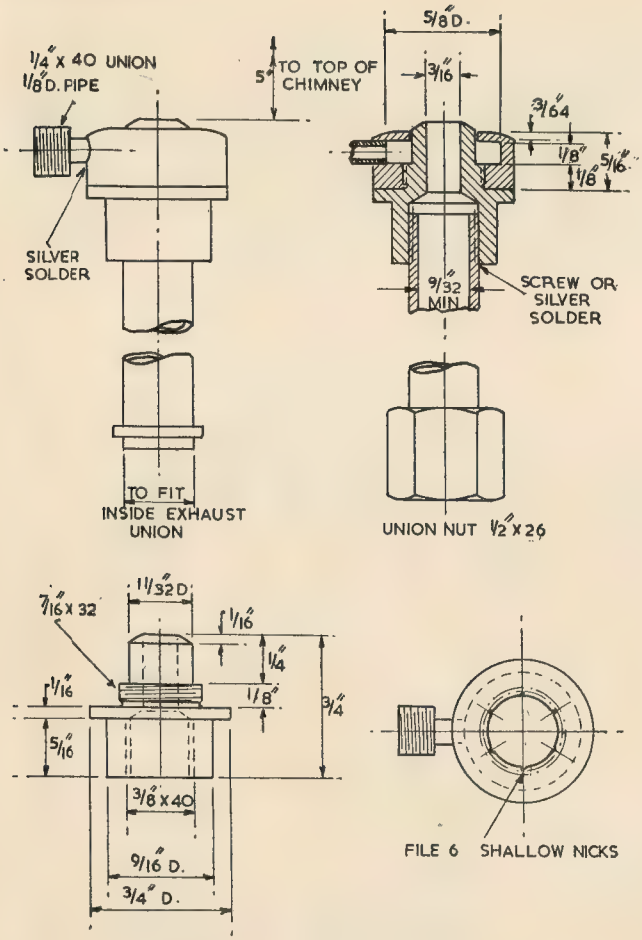
on the drawing, and for further guidance, let us consider them separately. First of all, the fitting is attached to the back end of the right-hand side tank. Don't worry about the footplate level, for this can be cut away round the fitting if necessary, so put the manifold as low as possible. The axle pump delivery connection is arranged so that a pipe may be made directly into it. This entails having the fitting placed with this connection sticking out a little, so that the pipe may run forward, hugging the inside of the side tank where there is room for it. The pipe should be made into a "Tee" at about the middle of the centre diaphragm where the pump is. The two branch pipes from the "Tee" then go to the two pump connections on top. The union marked "Axle pump delivery" carries a short pipe that runs straight up to the valve hole; this is for a fixing bolt to secure the whole fitting, but in all probability you will find the short pipe connection stiff enough to do all the holding. The valve spindle, if made to the dimensions given, should stick up above the top plate of the side tank by half an inch (over all). The union marked "Backhead clack" does just what its name implies. From this point, a pipe runs round in a gentle sweep and then turns inwards and upwards to the backhead combination fitting. The union marked "To donkey pump delivery" should be piped so that it sweeps round and forward, following the axle pump delivery pipe just inside the inner wall of the side tank; or else plugged off as suggested. If the pipe is fitted, it should also run through a "Tee" at some convenient point under the footplate, the branch from which will run to a

**Axle Pump By-pass Valve**

The use and positioning of this has already been embraced while considering the manifold itself. It is essentially a simple block of metal, drilled and tapped in the right places. It requires no pleasing shape or appearance for it spends its life in the dark, watery interior of the side tank. It should be a "fit-and-forget" unit with nothing to go wrong with it.

**Blast Nozzle and Blower Unit**

This is an entirely different story. The form and positioning of the blast nozzle and the blower unit is most probably the factor on which the complete success or complete failure of the engine may depend. I have lost count of the number of builders who, at various times and at various meetings have confided, "I would have brought her




**Blast nozzle (1 off, G.M. or brass)**

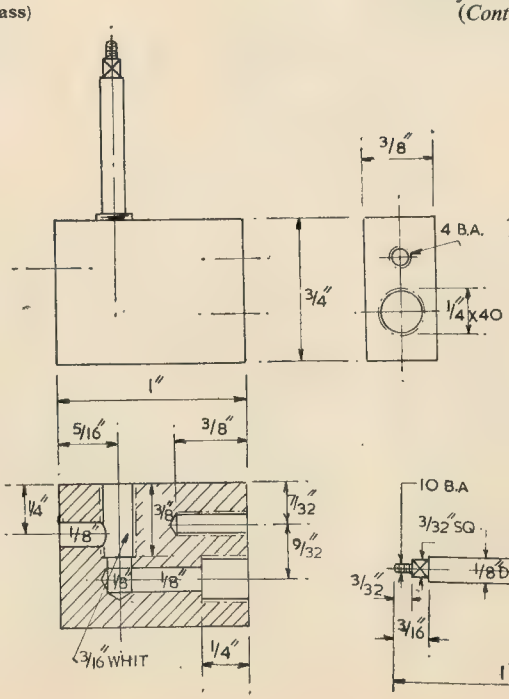
gives food for thought, and tends to emphasise that the ejection principle of the blast nozzle may, in its applied form, have many applications.

I favour a blast nozzle without "flare" and of a definite parallel length. The spread of the ejected steam is something that occurs quite naturally (to a point) and other internal smokebox disturbances tend to break up an arranged flare, in spite of its supporting theories. You may prove all this if you wish to spend a disgustingly filthy afternoon riding in front of somebody else's locomotive with the smokebox door open. When you have lost his fire for the fourth consecutive time, you may tend to become unpopular. Rude and offensive references to your lack of parentage and general delineation may be the only reply to a plea lodged in favour of research!

The blast nozzle as shown on the drawing is a fitting that I am pleased to record as one of my "standards." It is a two-piece affair, giving the operator a chance to separate the parts for cleaning purposes. It goes further than that, for by following the path of the smoky and oily substances that hare round inside every smokebox, it will be seen that at no time are these foreign matters impinging on the blower jets themselves. Oil from the blast nozzle is the main culprit in fouling up blower mechanisms, and when a fair amount of ash has been further added to the sticky mess, it is not uncommon to find the blower wheezing under an unholy and indescribable collection of filth—to its obvious detriment. All these things are mentioned to help the man who likes to remain in steam all day if necessary, and still enjoy peak efficiency at the end of it.

(*Continued on page* 159)

up to-day, but I can't get the blast right;" whilst another familiar phrase, "I find I have to keep the blower on slightly, or the fire dies on me" is heard with monotonous frequency. This is something that applies to all locomotives, regardless of their origin or design. It is no reflection on the designer of the small locomotive that the builder fails to carry out the exact details of the design. The point is this; a badly placed blast pipe, a badly *shaped* blast pipe, a leaky smokebox, a "skew-whiff" blower, an incorrect petticoat pipe (where fitted) may each or all knock an engine stone cold for steaming, and the exasperated owner may be tempted to write scathing letters of condemnation to whoever he thinks is responsible for his disappointment. Fortunately (touch wood!), no such letters have yet reached me, and need not reach me if builders of this little engine will faithfully and conscientiously follow the design given. Surprising things happen, Mr. Ron Bostel tells me, quite cheerfully and unblushingly, that his loco has never run better since the petticoat pipe fell out one day! That simple fact



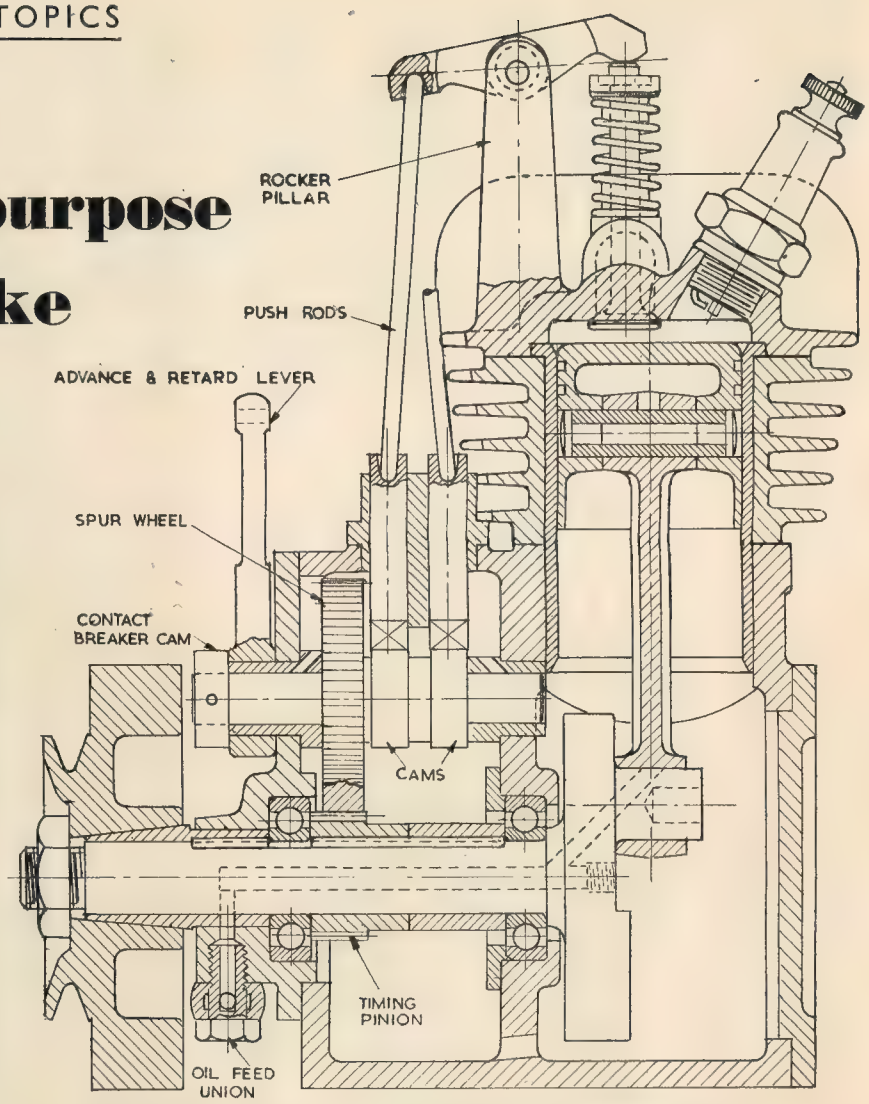

**Axle pump by-pass valve (1 off, G.M.). To fit in right-hand side tank**

**Below: Valve spindle (1 off, stainless-steel)**

# A 10 c.c. General-purpose Four-stroke

By

Edgar T. Westbury




**Sectional side elevation of 10 c.c. air-cooled four-stroke engine (full size)**

IT is quite a long time now since I described a design for a small i.c. engine of a type suitable for boat propulsion or "general utility" model work, and many readers have wondered whether I have lost interest in these engines, especially as I have lately been devoting a good deal of attention to the "rival" class of power units. The fact, however, is that I have as keen an interest as ever in the development of i.c. engines—but I had begun to fear that readers were no longer very interested in their construction.

While modern developments in the application of miniature i.c. engines as a means of propulsion for model boats, cars and aircraft have been spectacular and far-reaching, it can hardly be said that interest in the engines themselves (apart from using them as a means to an end) has increased; indeed, it is not too much to say that the contrary is the case. This, perhaps, is a prevalent modern trend, for neither motorists nor motor-cyclists seem to take so much interest in the engines or other mechanism of their vehicles as they used to in the good old days, so long as they push the said vehicles along satisfactorily.

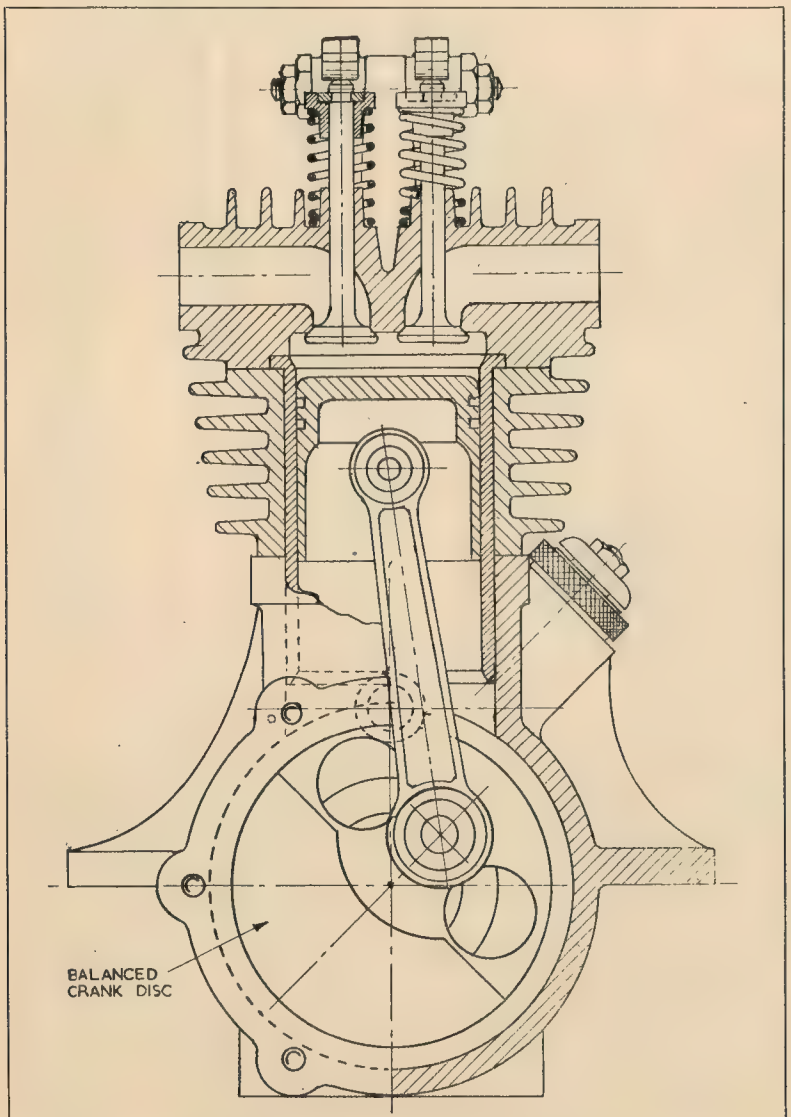
It is an unfortunate fact that many of the obvious blessings of our advanced civilisation have their reverse side, and in an age when comfort, convenience and efficiency are so readily available, there is a tendency for people to become both physically and mentally lazy. A few years ago, if the constructor of a model boat wanted an engine to drive it, there was nothing for it but to set to and make one; and though his efforts might have been clumsy and the results inefficient, he got a whole lot of fun out of it and learnt a great deal in the process. Nowadays, when he can buy a ready-made engine of unquestioned efficiency, he often decides that the time and energy required to build one is not worth while. (I know I shall be accused again of "subversive propaganda" against commercial engines, but this is simply an incontrovertible fact.) But my object in raising this point is not recrimination against either manufacturers or model users who take the line of least resistance, but simply to explain why I have not felt justified in publishing articles on the design and construction of small i.c. engines as often as I did before the war. As the barrow boy said when offered a job selling cat's meat: "There ain't no future in flogging a dead 'orse!"

Within the last year or two, however, there has been a noticeable change in the attitude of i.c. engine users, especially in the field of model power boat propulsion; and this appears to have been influenced by yet another modern development, namely the growing popularity of radio control. The engines at present available ready-made, although certainly capable of propelling model prototype boats at fair rates of speed, have been found lacking in certain characteristics which radio control enthusiasts consider highly desirable for this class of work. Of these, the most important is ease of, and facility for, flexible control. There are, however, several other features of the prevalent type of commercially-produced miniature engine which fastidious users are beginning to object to, notably the necessity to run them at extremely high r.p.m., with attendant noise and fuss; the difficulty of keeping boats clean and tidy where they are used; and, last but

not least, their dependence on expensive fuels, and abnormal appetite for them. I would like to make it clear that I am not making a personal criticism of such engines, as all these objections have been put to me by readers; but I am generally in agreement with them.

The general result is that there is now a strong demand for engines of larger size, capable of a wide range of control, and with a good margin of power at moderate speed, quiet running, and unimpeachable parlour habits. There is, of course, no guarantee that home-built engines necessarily fulfil all or any of these conditions, but it is possible to design and construct them to do so. The type of engine quite rightly favoured for this class of work is a four-stroke spark-ignition engine of about 10 c.c. and upwards, and no such engine is at present available ready-made, though there was one put on the market a few years ago. This particular engine has proved its worth in model radio-controlled boats, and is now very much in demand—but too late. It is a great pity that engine enthusiasts did not recognise a good thing when it was available. At present I see very little prospect of anyone attempting to produce another four-stroke engine of this class on a commercial basis, as its multiplicity of working parts, compared to the two-stroke, renders it much less suited to quantity production to sell at a reasonable price.

When I introduced my first 15 c.c. petrol engine, no less than 20 years ago, I described it as a "hack," or general-purpose engine, and this title has been amply justified by its subsequent history, as it has been successfully applied to practically every purpose within the limits of its size, including racing and prototype boats, cars, aircraft and locomotives, not to mention electricity generators and other stationary plant; moreover, its design has been used as the basis for many individual efforts. Under its acquired title of the "Kiwi," it is still quite popular, together with its more elaborate and efficient companion, the "Kittiwake," of similar size, and the "Kittyhawk," of 30 c.c. Castings for these engines, and others of my design, have been marketed by Messrs. G. Kennion & Co. of Kingsland Road, London, E.2, but readers have reported difficulties in obtaining supplies in recent years. In any case, the 15 c.c. engine, which at one time was considered the smallest practical size for really useful work, is now quite a giant as miniature engines go, and few of my readers have asked for anything larger than 10 c.c.




**Half-sectional end elevation, from crankpin end**

The present design has been evolved from long experience with the above-mentioned types, and embodies many well-tried features, together with a few new ones which have been fully tested in experimental designs. It may, however, be said that some of the features have their roots still further back than the date at which the "Kiwi" was first described. In a series of articles published at the end of the war, I mentioned my early experiments with four-stroke design, including three engines classified under the name "Apex," only the third of which, the "Apex Minor," has ever been described in THE MODEL ENGINEER. All these engines were unconventional in their structural design, particularly in respect of the arrangement of the crankcase and timing gears, and at the time they were designed there was little enthusiasm among my friends for these departures from so-called "standard practice." As a result, I came to the conclusion that it would be more discreet to revert to more familiar principles of design, at least for the time being. Daring departures in design, even though they may be admired, are always regarded with a certain amount of mistrust, and slavish adherence to convention has often retarded the march of progress. You will always find that if something really new and ingenious turns up at a motor or motor-cycle show, there will be an enthusiastic crowd round the stand—but the salesman's order book will have a strangely blank look !

Later events have shown that in at least one important respect, my misgivings as to the prospects of popularity for the "Apex" engines were justified; namely, in the use of right-angle skew gearing for the camshaft drive. This has never caught on with amateur constructors, even when the appropriate gears were readily available, though there is much to recommend it. There

has, however, been some change of attitude regarding conventions in the external appearance of engines, and the time-honoured features introduced by De Dion and contemporary makers are no longer insisted upon.

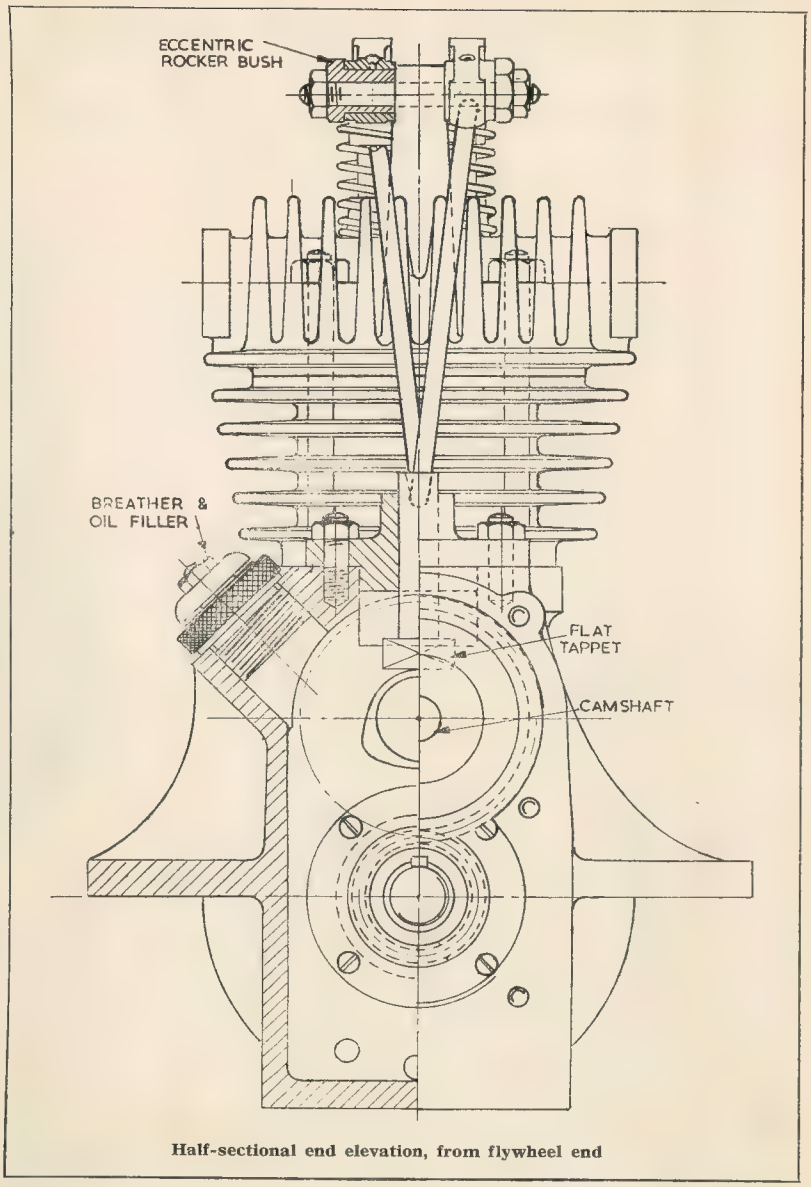
**Salient Features**

The present design has a crankcase of box girder construction, based on that of the original "Apex" engine, the object of which is to obtain the utmost possible rigidity under all working conditions. An overhung crankshaft is employed, as this can be made more rigid than the conventional double-ended shaft for a given size and quantity of metal used, and is, therefore, less liable to deflect under load. Spur gears are used for timing, and are of robust dimensions; the minimum size of pinion is governed by the need to fit it on the crankshaft without reducing the latter's diameter, but one incidental advantage of large gears is that they enable the camshaft to be placed high, thus reducing the length of push-rods necessary for operating the overhead valve-gear. The entire layout of the valve mechanism is designed to obtain high mechanical efficiency, and this includes the use of direct flat-ended tappets working in conjunction with convex-flank cams, also straight rockers to operate vertical valves in the head.

**Valve Gear Efficiency**

It may be mentioned here that many readers who have corresponded with me on the matter of engine design are very much in favour of overhead camshafts, and have asked me to incorporate this feature in one of my designs. I am fully aware of its potential advantages, for certain purposes, but I cannot agree that there is much to be gained by adopting it in a small engine, designed expressly for amateur construction; its disadvantages tend to outweigh its merits in this case. First, its success depends almost entirely on highly efficient gearing, which is extremely difficult to obtain in small gears such as can readily be obtained or produced by the constructor. Secondly, its superiority over the more common push-rod arrangement, if obtained at all, applies mainly to long running periods rather than sprints of short duration, such as are usual in small engines. Thirdly, and by no means least important, it increases the top weight of the engine, as the overhead working parts must be robust in themselves and also adequately supported; and top-heaviness is already a besetting sin of powered models with existing engines.

Another much-discussed point is that of the arrangement of the valves themselves. While it is generally agreed that inclined valves, in a domed head, are desirable, there are many problems in using them to the best advantage, and in a small engine, the mechanical complication of the gear necessary to operate them lowers the mechanical efficiency. Moreover, the theoretical advantage of the domed head is questionable when high compression is employed, as its essential object of forming a compact combustion space is defeated. An even more serious objecton in practice is that if the valves "float" at high speed—as they will do on the best-designed engines on occasions—they are almost certain to get bent by hitting the piston, whereas vertical valves will survive a certain amount of this abuse without damage.




**Half-sectional end elevation, from flywheel end**

**Cylinder-head Cooling**

One of the practical difficulties in small four-stroke engine construction, at least when air cooling is employed, is that of providing adequate finning on the cylinder-head. Most of the engines produced by amateur constructors have far too little fin surface—even some of my own designs, owing to casting difficulties, have neither so many nor so deep fins on the head as I should wish—and this often proves to impose a limit on the power that can be maintained by the engine after it has warmed up. It is not sufficient to provide liberal finning on the barrel, which encounters nowhere near such a high internal temperature as the head. In two-stroke engines, it is fairly easy to machine fins on the head, and moreover, though they may run much hotter, they do not have to cope with valve cooling problems and risk of distortion of the valve seatings.

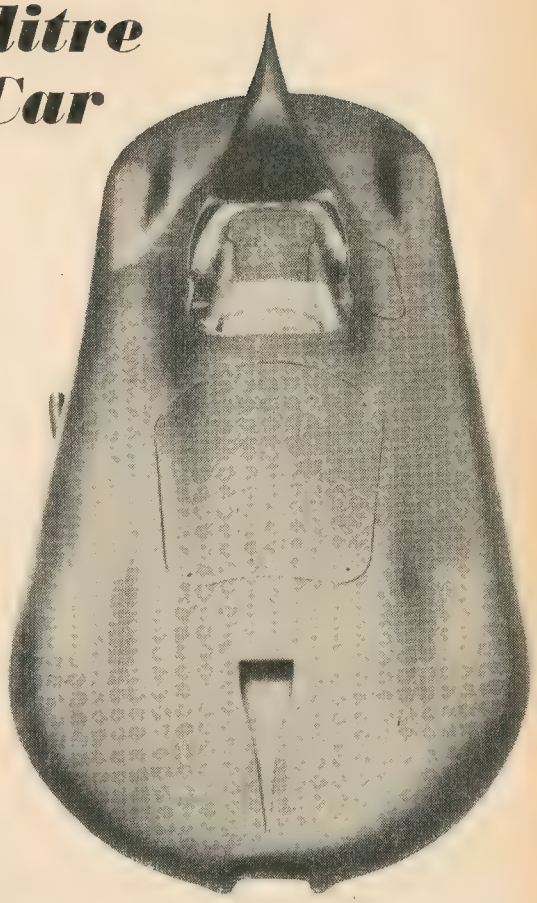
I have taken a great deal of pains to

(*Continued on page* 162)

# The Connaught 2½ litre Formula 1 Racing Car

*AN EXCELLENT SUBJECT FOR MODELLING*

**By J. Dewar McLintock**



THERE is undoubtedly an increasing interest in model cars and models of other types of motor vehicles, motor-cycles, etc. This has been underlined, among other factors, by the more frequent appearances of such models at exhibitions and club events, by the results of a recent model motor-cycle competition, and by the increasing numbers of good commercial miniature cars and car-kits.

It is felt that the following brief account of a current project in the motor racing field will be of interest to many actual and potential model-makers, not only because this example seems to lend itself so well to reproduction in miniature, but because the small scale drawings and dimensions may be of value, whilst the technical features are interestingly representative of modern practice.

This Connaught car, in fact, not only represents the most advanced phase of contemporary design in aerodynamic enveloping bodies, but exemplifies the salient features in current chassis design—e.g. the wide use of round and square-section tubes, torsion-bar suspension, rack-and-pinion steering, etc. Many modelmakers will appreciate that these constructional features are, in many ways, easier to reproduce than those of earlier, more traditional cars, in which laminated springs, worm-and-nut steering, and frame members of varying channel section were customary.

Connaught Engineering is, I understand, a non-profitmaking concern which does not receive outside financial support. It is financed entirely by Kenneth McAlpine, whose undying wish is to see a competitive British Grand Prix car on the circuits of Europe. In the Surrey village of Send, progenitor Rodney Clarke has charge of an enthusiastic band of 40 draughtsmen and engineers and a cluster of small modern workshops.

The prototype car was ready for track tests in August, 1954, and these trials will continue until the car is race-perfect, and under no circumstances will the prototype appear in international events until the most exhaustive tests have been completed.

To have produced a successful technically unorthodox car would have been a lengthy process, so Connaught have drawn on their own fund of many well-tried and fully developed ideas and woven them into a completely new basic design. To these ingredients has been added one outstanding feature—an all-enveloping fully streamlined body, smooth in contour, devoid of excresences and aesthetically attractive.

Large-section steel tubes are employed for the main chassis members. There are two parallel side members of 3¾ in. diameter 16-gauge tubular steel, with four cross-members of the same dimensions welded into position at right-angles. Welded to this is a basic superstructure of smaller steel tubes and square section tubular members. This combines bracing for the chassis with mountings for the instrument panel and the body structure.

Built across the forward end of the main chassis frame just aft of the front cross-member is a rigid, welded box structure which provides the anchorage points for front suspension components. The front suspension is independent by two square-section, tubular wishbones of unequal length on each side, and there are combined telescopic damper and helical spring units. These suspension units are located at their upper ends at a mounting on the box structure. They pass through the top wishbone on each side and are attached to brackets on the lower wishbones. Each of the lower wishbones is linked to a torsion bar which runs transversely through the front cross-member of the chassis.

Steering is by rack-and-pinion with the gear itself mounted transversely on a step on the forward face of the front chassis box structure. It is positioned forward of the hubs, and all the ball joints in the connecting arms are in yokes. The gearing is arranged to give two turns from lock to lock and the geometry is such that there is almost no Ackerman.

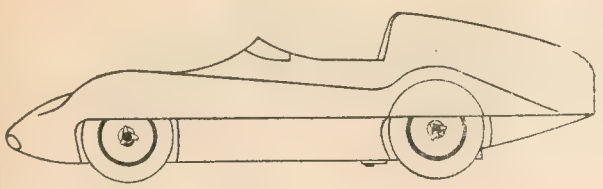
The new Connaught employs a De Dion type rear axle. In this layout, the De Dion tube is located by two radius arms, one on each side, running forward of the axle. They are mounted at their forward ends on an outrigger support, about mid-way between the two central chassis cross-members.

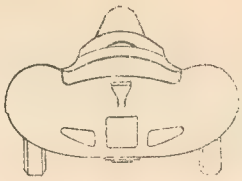
Braking torque is counteracted by a short torque arm jointed at each end, which is anchored at a central point on the De Dion tube and a mounting on the top of the differential casing. Lateral location is provided by a short compound linkage on the nearside which has the same effect as would a full-length Panhard Rod.

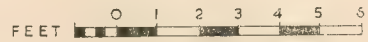
This layout is used in conjuction with a longitudinally-disposed torsion bar on each side. A short shackle and a straightforward arm link the axle to the torsion bars on each side.

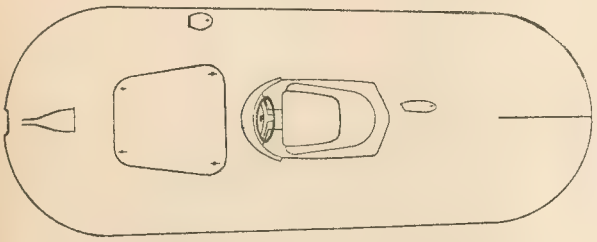
Almost any available Grand Prix engine can be accepted by the readily adaptable chassis. From the rear of the engine a prop-shaft connects to a four-speed pre-selector gearbox which is positioned aft of the driver, close to the rear axle.

The final drive unit is in a magnesium alloy casing ; it incorporates a double reduction gear which allows for up to a four-per-cent. variation in axle ratio to be speedily effected. The unit is rigidly positioned in strong mounting-plates which are welded to form an integral part of the main chassis frame. Universally-jointed shafts provide the final drive from the differential to the







| | |
|---|---|
| WHEELBASE | 7' 6" |
| TRACK — FRONT | 4' 2" |
| REAR | 4' 2" |
| LENGTH OVERALL | 14' 4" |
| WIDTH | 5' 6" |
| GROUND CLEARANCE | 4" |
| WHEELS — FRONT | 16 X 4½ WITH 16 X 550 TYRES |
| REAR | 16 X 5 WITH 16 X 600 TYRES |
| FUEL CAPACITY | UP TO 65 GALLS |
| ENGINE | ALTA |
| CYLINDERS | 4 |
| BORE | 93·5 MM |
| STROKE | 90 MM |
| CAPACITY | 2470 CC |
| FUEL SYSTEM | S.U. FUEL INJECTION |
| GEARBOX | ARMSTRONG SIDDELEY SELF CHANGE |

**Elevations and plan of the 2½-litre formula 1 Connaught racing car**

wheels. It is particularly interesting to note that disc brakes are included in the specification.

The aluminium coachwork of the streamlined car is 14 ft. 4 in. long and 5 ft. 6 in. wide. It encloses the driver up to shoulder height and features a large combined head-fairing and fin. In the nose of the body there are air intakes for the front brakes, the radiator (which is an ultra-light alloy unit) and the engine. Unobtrusive ducts, low down in the side of the car, direct air on to the the rear brakes. The underside of the chassis is also fully faired in.

The complete body is divided at its waist-line, so that in a matter of minutes the complete top half can be removed. Fuel tanks housed in the tail of the car and on each side of the driver, provide a total capacity of about 50 gallons.

From the general aspect of the car, it will be noted that the driver sits well towards the forward end. His feet are, in fact, on each side of the engine. This has been arranged so that in conjunction with a downward sloping bonnet line, the driver can obtain the best possible forward and side visibility.

# Twin Sisters

(*Continued from page* 154)

Again, the drawing should make everything abundantly clear, although I shall add a rider. The filing out of the six grooves that form the blower jets is a job that needs a little care. Try to keep these all equal—and parallel. Err on the shallow side to start with, and if, when you first steam the engine, you find blower force is lacking, it is not much of a job to unscrew the top half and increase the notch depth all round.

**The Puffing Engine**

I am intrigued. Over the course of the last few years, I have heard that an engine that *didn't* puff, was woolly, inefficient and poorly made. Bronchial "Chiss-chiss" was a malady, but a good hefty G.W.R. "Chonk" was anything *but*.

We, as miniature locomotive fans and builders, boast of sizes, arrangements of cylinders and valve-gear that are legion. Most small locomotives will bark if you *make* them; most will run gently and near-inaudibly if you let them, for much depends on the driver. Going up the bank with a big load (and I *mean* a big load) in full gear and plenty of steam on the clock will produce noise and pyrotechnics. Some drivers do it because they like both effects and don't care two hoots what it does to the fire. Some drivers have engines with small cylinders and snappy piston valves and enjoy struggling away with loads of about 1,500 scale tons behind them—no wonder they bark! Let's face the facts. A big engine with large cylinders and well-made valve-gear may well have a power factor miles above its qualities of adhesion. There are plenty that fall into this category, and they seldom kick up any fuss, mainly because they *can't*. A big engine with small cylinders, high boiler pressure, and piston valves, plus the adhesive weight to really hold it down, will produce a merry old sound when she is working hard and not notched up to middle. This need not denote inefficiency—it may well be the opposite!

If you are interested in efficiency, then let it be measured in fuel consumed and water evaporated, or, if you like, the simple terms of "work done." There is no other way in which true efficiency can be measured, so don't be mislead by anything that anybody may suggest to the contrary.

Further, I suggest that you remain individualists. If you like an engine that goes "chonk-chonk" up the bank, then let your hair down—give yourself a treat; it's *your* engine and you are running it for your own pleasure. Don't let anyone spoil your fun!

(*To be continued*)

# L.B.S.C.'s Lobby Chat

## "TRICKS OF THE TRADE"

SOME correspondence that I had with a fairly new reader about a locomotive that was a bad steamer brought to mind some of the antics that full-size drivers and firemen used to practise, in the happy days of long ago; and maybe still do! In this particular case, it was the old tale about taking advice from the well-known person who always "knows better"; and instead of my specified grate and ashpan being fitted to the engine in question, the spaces between the bars were made half as wide again, and the ashpan deepened until it was almost at rail level, both ends being left open. Incidentally, these facts were not disclosed until several letters had passed, in which I had carefully explained various possible causes of the shyness of the boiler to produce the needful; and to cut a long story short, when a grate and ashpan were fitted according to specification, the boiler steamed like a witch, and has done so ever since.

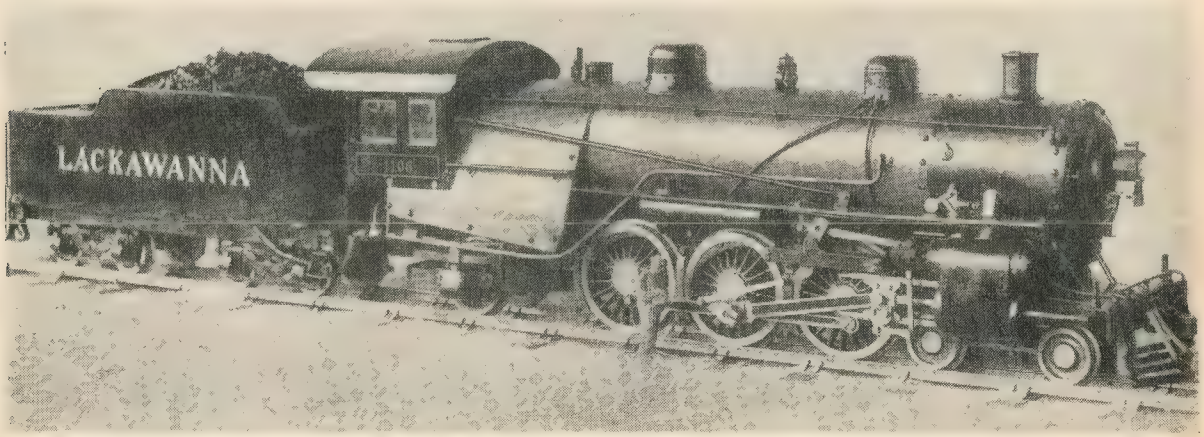
However, cases sometimes arise which are frankly puzzling to builders of small locomotives who haven't been initiated into the craft of full-size locomotive operation. At the close of the past year I received a letter from a Scottish reader who is by way of being a "precision" worker. He follows the "words and music" all right, but takes mighty good care that everything is what my old granny used to call "just so"; the joints in his valve gears, for instance, are made as perfectly as if the penalty for any slackness was to be stood up against a fence and shot at dawn. He also adds many of the fancy touches that you find in full-size engines, such as valve-spindle guides and so on. Well, one of our friend's earliest jobs was a *Dyak*, and it would have been a puzzle for Inspector Meticulous to find any fault with the workmanship and fitting. When burning Welsh coal, she did the job that all respectable locomotives do, in the approved manner, hauling big loads, and keeping a full head of steam with the pump working, and the firehole door open a little; but when he ran out of Welsh coal and tried Scottish anthracite, she went as dead as ditchwater. The fire wouldn't burn brightly, and went out on the slighest provocation.

Our worthy friend said that he didn't want to add to my burden of correspondence if it could be avoided—a kindly thought for which I thank him—so he tried altering the grate, firebars, and spacing, adjusting height of blast-pipe and liner, and various other wangles, but didn't get any better result. As he is now building a *Doris*, and wished to fire her with the local fuel, he wrote and asked if I would recommend any alterations which would make this possible.

**Just Like Big Sister!**

Our friend's letter brought memories of the old days on the L.B. & S.C. Railway, where we very often experienced exactly the same trouble. The Stroudley engines were at their best with a good bit of Welsh coal in the firebox; and the distance they would run, and keep steam up to blowing-off pressure, on one firing, was amazing. I recounted in past reminiscences how it was possible, with a train of moderate weight, suited to the power of the locomotive, to make up the fire when leaving Victoria, and run right through to Brighton, 50½ miles, without putting any more on. Naturally, it required considerable top-grade enginemanship on the part of both driver and fireman; the driver left the regulator wide open, and made careful adjustment to the cut-off according to the grades, and speed required to keep time. The fireman watched the steam and water gauges like a cat waiting at a mouse hole, adjusting the pump feeds to suit the demand for steam, keeping the needle on the 150 lb. but never letting the "balances" (spring-balance safety-valves) lift and waste the precious vapour. He took an occasional look at the fire as it burnt down, levelling or lifting it as required, towards the end of the trip, so that there would be no black spots, and no air holes; and the engine would quietly slide into the terminal station with just enough to cover the bars, water near the top of the glass, and from 100 to 120 lb. on the "clock." *What* a difference to modern practice! Some of my correspondents, who are working enginemen, have told me about trips where the fireman has never put down the shovel. Did I hear somebody whisper "spam can?"

In addition to Welsh coal, we sometimes had other varieties, such as Yorkshire, which was known as "hard," and some peculiar stuff that we called "dum-dum;" the locality from which the latter




**A 7/16-in. scale Lackawanna Pacific by Mr. Geo. Bender of the New York S. of M.Es. Spirit-fired when first built in 1915—still working.**

originated, I can't recall for the moment, but it had less " therms " than any of the others. It was impossible to do the one-firing-per-trip stunt with the hard coal, as it burnt away too quickly, and, in addition, was very smoky. It made plenty of steam, but needed special treatment to keep the smoke down; the fire had to be kept thin, and the air supply over it, necessary to consume the smoke, carefully regulated by aid of the firehole door. The Brighton engines in those days, had no baffle plates, as the doors opened inwards, and formed their own baffles. By opening the door just a wee bit, a current of air was directed on to the fire at just the right angle to burn the smoke, but avoid cold air getting at the tubes and making them leak.

Mr. H. Richardson's 5-in. gauge " Dukedog " with " Minx " cylinders and motion

**Ways and Means!**

Whenever a depot was blessed with a few wagon-loads of " dumdum," the " coalies " did their best to mix it with some of better quality, and so prevent many new words being added to the dictionary of rail road Esperanto by long-suffering engine crews who had to do their best to get along with it. Some of the stuff was about as inflammable as granite, and ordinary methods of firing were useless. It had to be broken into smaller pieces than usual, and needed a terrific blast. The drivers used to get this by putting a " jimmy " in the blast nozzle. Most of them were improvised by getting a short length of the steel rod used for making tube sweepers and washout rods, bending one end into a hook, to fit under the lip of the blast nozzle, and attaching a fishplate to the other end. This would split the jet of steam, and pull more air through the fire. Some of the depot blacksmiths made a bit of " overtime " by making screw jimmies and selling them to drivers and firemen for a few pence each. They were made of square iron bar, one end hooked to fit under the nozzle lip, as mentioned above, and the other end bent over and fitted with a clamp screw and butterfly nut; the bar was arranged so that when in position, the angle edges were at top and bottom. They could be fitted and removed in a matter of seconds, and were more effective than the thin round rods.

The use of a jimmy was " against the rules," as a boiler that was forced by extra blast, usually developed leakage; but " needs must where the devil drives," and the officials (who had learned their jobs the hard way, and were far different from the college-trained variety prevalent nowadays) always " winked the other eye " when it was a case of getting along with poor quality coal. Incidentally, I was very surprised indeed to note on a drawing of a Chapelon engine, of the days before the French railways were nationalised, a blast nozzle with a permanent jimmy, in the shape of a cross, cast in the top; no wonder they steamed on briquettes! Some of the old Billinton radial tanks needed two jimmies, placed crosswise, to make them steam; and, on one occasion, when one of the earlier batch with 4 ft. 6 in. wheels (if memory serves me rightly, it was 457 *Watersfield*) was acting as pusher to a 60-wagon train at the bottom of New Cross-Forest Hill bank, she was the heroine of a funny episode. She had the two jimmies in, and in an endeavour to get a good start on the three-mile climb, the driver " gave her the lot "—full regulator and full gear. The blast was so terrific that she blew the jimmies clean out as she went through the station, and they fell on the down local platform. A schoolboy, who had been taking engines' names, saw them fall, got a piece of waste, which a porter had been using for lamp-cleaning, picked up the jimmies with the fishplate attached, and took them across to the depot superintendent's office (the depot adjoined the station) with the naïve explanation: " Please, sir, this fell out of one of your engines! "

" Dumdum " coal wasn't supplied to passenger engines if it could be avoided; and as drivers who had their own engines looked after them in a way unknown under present conditions, they were mighty careful when force of circumstances compelled them to burn the stuff. One way of getting a sharper blast without using a jimmy was to run with a later cut-off than usual, and drive on the regulator; this was very much against traditional Brighton practice, where full regulator and the earliest possible cut-off was the order of the day—and night! There were other subterfuges; but if I go rambling on about them, all my space will be used up without telling the sequel to the Scots locomotive-builder's trouble.

**Following Full-size Practice**

In view of the above, I thought that maybe the Scottish anthracite that apparently wouldn't burn was first cousin to our " dumdum " of not-so-blessed memory; and to make quite certain on this point, I asked our friend to send me a sample of the stuff, so that I could try it on one of my own locomotives, and make sure that it really was coal, and not a specimen of tarmac that had been supplied to him! The sample duly arrived; and with it was another sample of a kind of coal called " Polmaise," which he said was supposed to be the cat's pyjamas around his way, and which he had not yet tried out; so would I see what that was like, as well? I'm always ready to do a bit of experimenting, as that is how I got what knowledge I now possess; and why, when I state *actual facts* in these notes, all the figures put forward by theoretical " experts " cannot confound them. You may remember that it was " proved " by figures that the adhesion of the driving wheels of Stephenson's *Rocket* was insufficient to climb the bank at Rainhill, even without load; that a steamship could never cross the Atlantic Ocean; that a machine heavier than air, could never fly—I wish to goodness that they had been right in that contention!—and so on and so forth.

As I was intending to test my usual batch of Christmas-present injectors on Christmas Day, I thought to kill two birds with one shot, and try the coal at the same time. Incidentally, I'm now well into my second hundred of the injectors; they soon tell up, making a dozen or more at a time, and they are scattered all over the world. When I read about the song-and-dance made about a few leaky boiler fittings, I just can't resist a chuckle—nuff sed! On this occasion, I gave old *Ayesha* a rest, and tried the injectors on *Tishy*, the 2½ in. gauge Gresley Pacific; they all panned out O.K. so I got busy with the coal. On firing up with the Polmaise, a cloud of grey smoke came out of the chimney, but this soon disappeared as *Tishy* got into her stride. After three laps, the needle of the steam gauge began to move in the wrong direction, so I took a look in the firebox, and found that the coal had caked into a solid lump which was alight around the outside. I prodded it with the pricker, and broke it, but after another lap it caked again, and as the engine was rapidly losing pressure, I stopped her. The lump was quite hard, and I had to break it up before I could get it out of the firebox.

The fire was relit, and some of the

Mr. John Fowler's "Great Northern" in wartime livery

Scottish anthracite fed in on top of the lighting-up charcoal. My Milly-Amp blower creates a tidy draught, and in a couple of minutes or so, we were ready to be away again. Off went *Tishy* in her usual style, but she never started to blow off as she gathered speed, as she usually does; and when I notched up to her usual running position, pressure began to fall. On looking in the firebox, I saw that while the fire was all alight, and no caking, it was very dull, and didn't seem to have much heat. My mind went back to "dumdum" days, and I thought I'd try the old wheeze of dropping the lever and giving her extra blast, so I did; and exactly as in full-size practice, it worked. The fire brightened up, and steam pressure crept up to 80 lb. where it remained, though the boiler never blew off like it usually does when the firehole door is shut. She also lost a few pounds every time the injector was put on; and she used more of the anthracite than the coal I usually burn. Exactly the same result was obtained in a narrow firebox; if I tried to run with the lever in the usual position, the engine lost steam, but would recover if run with late cut-off and sharp blast.

The anthracite itself was quite clean and free from dust, but the little nuggets were dull black, and hard as stones. Anybody who wished to use it regularly in the firebox of a little locomotive would have to arrange blast nozzle and chimney liner to get maximum draught without back-pressure; and it would be worth while trying the French blast nozzle with a permanent crossed jimmy, which could easily be made by silver-soldering two wires across the orifice.

I shouldn't advise anybody wasting their time in trying to alter the arrangement of firebars and spacing that I always specify. I got my results by actual experiment, based on full-size practice. At the time I did my little bit of trying-out, the ratio of air space to grate area varied from 1 to 3, and 1 to 4, on most full-size locomotives; and, to the best of my knowledge and belief, things haven't altered very much since that time. The width of the bars, and the space between them, depends considerably on the kind of coal used; and the wretched stuff dished out by the National Coal Board to the nationalised railways in the present year of disgrace may possibly need some modification of the above ratios. Anyway, as everybody with the average amount of common sense will at once realise, it was just as futile to try "scale" firebars and spacing, as "scale" number and diameter of tubes; so I just used that little bit of locomotive instinct that nature was kind enough to allot to me, and schemed out what I thought would be a satisfactory arrangement. In my first grates, I had the bars too narrow, and they burnt away rapidly. The old Brighton engines had what we used to call "cut" bars, made of iron, $\frac{3}{4}$ in. wide at the top, and $\frac{1}{2}$ in. wide at the bottom, very closely spaced. Nature won't be "scaled," as we all know, but some are loath to admit; anyway, when coal is burned in a full-size firebox, and in a $3\frac{1}{2}$ in. gauge firebox, the ash from it is exactly the same, in either case.

To cut a long story short, I found that in the little engines, the best results were obtained by making the air space approximately half the grate area, the width of the firebars and the air spaces being equal; and those good folk who have built locomotives described in these notes can confirm that, with average workmanship, there is nothing wrong with the steaming. Up to 5-in. gauge, bars and spaces should be made according to the drawings given; for larger engines, they can be modified a little, in accordance with full-size practice.

# PETROL ENGINE TOPICS

(*Continued from page* 157)

produce an adequately cooled head for this engine, but it has only been possible to do this by co-operation with the moulders, as the casting is by no means an easy one to produce. Before the design was finalised, the pattern-maker and the moulder were called into consultation, and their views as to any modifications which would simplify casting without affecting efficiency were carefully considered.

**Adaptability**

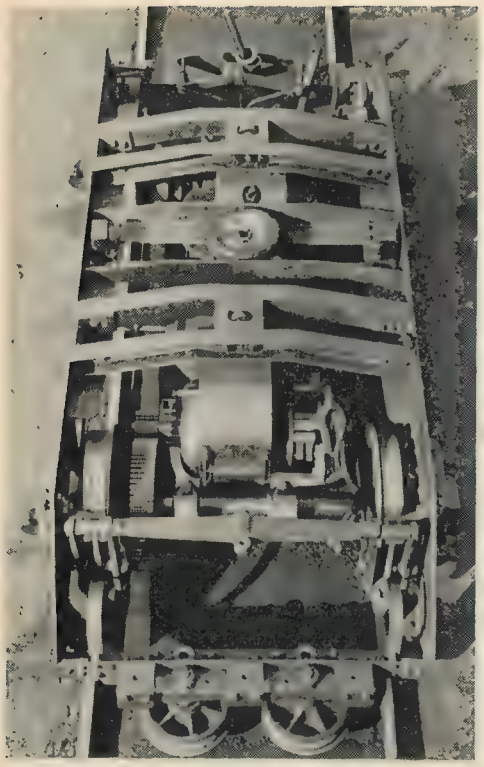
The policy of arranging the design so that it can be modified and adapted in various ways, which I have always observed, has been carried a step further in this engine. It can be constructed in the simplest possible basic form, and will give satisfactory results within the limits which this imposes, or it can be elaborated to increase efficiency or reduce the amount of running attention which it requires. Thus, although ball-bearings are specified for the crankshaft, it is permissible to use plain bushes by slight modification of the housings, and two or three different methods of lubrication may be employed, including an engine-driven pump, details of which will be given. Alternatives are also arranged for in respect of carburation and ignition, a special carburettor having been designed to give maximum flexibility of control. Glow plug ignition is possible, but not recommended; either a really efficient battery-coil system or a magneto will give the best results on normal fuels.

In keeping with modern tendencies in stroke-bore ratio, this engine is "oversquare," i.e., the bore exceeds the stroke, but even this is subject to modification, and it is quite in order to increase the engine capacity up to a maximum of 15 c.c. simply by lengthening the stroke. This feature may perhaps be criticised, but it is not without precedent in engineering practice; for instance, it is by no means uncommon for electric motors to be made in one frame size to cover a range of power ratings.

No claims have been made for the maximum power which may be expected from an engine made to this design if tuned for racing, but I have very good reason to believe that it will compare favourably with most two-strokes in this respect.

(*To be continued*)

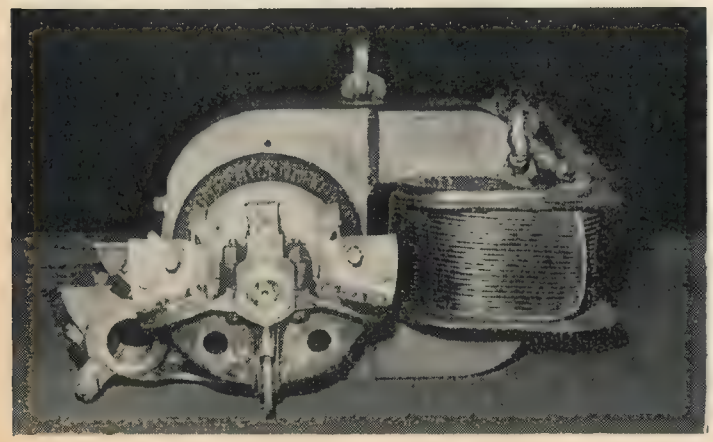
# A Narrow-gauge Electric Bogie



MR. A. McMULLEN, a reader in the Isle of Man, has sent us the photographs which are reproduced herewith. They consist of different views of a bogie as used on the cars of the Snaefell Mountain Railway, which climbs to 2,000 ft. above sea level. The railway was opened to traffic in 1895; the gauge is 3 ft. 6 in. and the length is 4¾ miles. There is a centre rail which, however, is used only for braking.

The cars were built by G. F. Milnes & Co., and each seats 48 people; but the main interest lies in the power equipment. Each car has four 550-volt d.c. " ring-wound " motors, built sixty years ago by Mather & Platt Ltd. They have little protection from the weather, and Mr. McMullen states that the way they stand up to rainstorms, brake dust, etc., is remarkable.

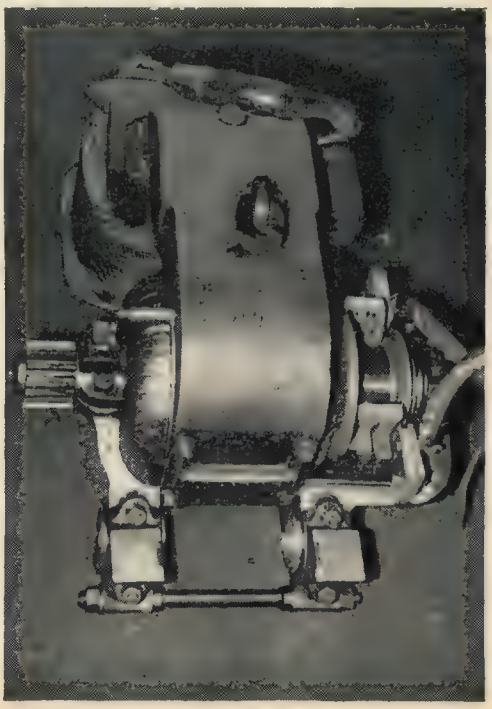
The photographs were taken by Mr. J. E. Barnes of Douglas, and quite apart from the historical interest of the subject, we feel that they will be of use to any readers engaged on the construction of large-scale electric locomotives for passenger-hauling. The platework on the Manx examples is obviously simple and light, but robust.



**Top left: View of bogie from above, showing general arrangement of motors, etc.**

**Middle left: The bogie seen from the side.**

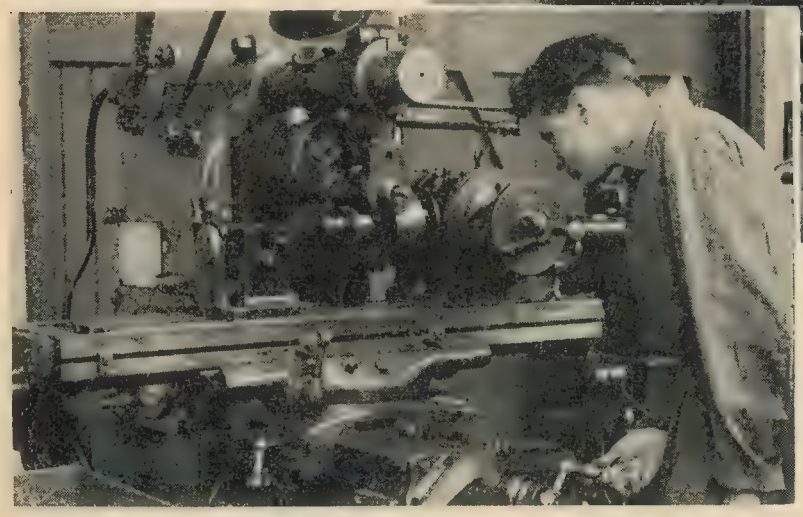
**Bottom left and below: Side and front views of one of the motors**



# Technicians of Tomorrow

## By Antony Glasier

FOUNDED in 1936, the South East Essex Technical College at Dagenham draws approximately 90 per cent. of its students from a five-mile radius. This area includes, in addition to Dagenham itself, the densely populated, highly industrialised boroughs of Barking, Ilford, and Romford. An indication of the main type of industry in the area comes from the fact that the mechanical engineering department of the college is the one with the greatest number of student-hours worked. This department has 2,000 students—60 of whom are full-time, 868 are part-time day release, and the rest attending evening classes.



**A boy carries out a cutting-tool-angle experiment with a test lathe**

**Left: Learning the use of a universal milling machine**

As the college is situated at Dagenham, the home of Ford cars, it will come as no surprise to learn that among the courses run by the mechanical engineering department are several directly associated with motor engineering, including motor body work, motor vehicle electricians' work, and motor mechanics' work. The college is almost certainly as highly developed for providing training in this branch of engineering as any college in the country, and has an interesting arrangement whereby several instructors from the Ford Motor Co. Ltd. are full-time instructors to a certain group of students at the college.

Other departments of the college, which has a total of 8,000 men and women students, are physics and mathematics, arts, building and surveying, commerce, domestic science, and chemistry and biology—various forms of chemistry being the next biggest local industry after engineering. Sharing the fine college building is an associated boys' and girls' secondary technical school with a total of 1,000 pupils. This provides an ordinary grammar school education for the first two years. For boys the third year bias is towards building and mechanical engineering, the latter including instruction in the elementary stages of workshop practice.

Part-time and evening National Certificate courses provided by the mechanical engineering department, whose head is Mr. R. S. Paradise, are electrical engineering (ordinary and higher), mechanical engineering (ordinary and higher), and production engineering (higher). City and Guild courses include boiler house practice, welding, machine shop engineering, pattern making, sheet metal work, telecommunications engineering, and also the various types of motor engineering mentioned above. Extensions to the mechanical engineering and related science departments are in hand and when completed will provide laboratories for electronics, telecommunications, radio, and instrument technology.

The 60 full-time students of the mechanical engineering department are studying motor engineering under the Ford scholarship scheme. A total of 18 students—12 from public and grammar schools throughout the country and the remainder from employees at Fords—are admitted per year. They receive a three-year general course in mechanical engineering with a bias towards motor engineering. Although it is a college-based course and the students use all the facilities of the college, including a very well equipped motor engineering shop, their supervisor and motor workshop instructors are Ford employees who spend most of their time at the college teaching this group of students.

For instruction in machine shop

practice, which is identical to that given to other students at the college, they attend the ordinary machine shop under Mr. D. S. Hattersley, who is a member of the college staff and is lecturer in charge of production engineering. The general direction of the scheme is under the principal of the college, Dr. F. Heathcoat, though Fords assist in selecting the students. Dr. Heathcoat states he has found that no difficulties have arisen from the dual character of the scheme. This type of scheme, which allows boys to be full-time students unrestricted by considerations of production, might be considered by other industries.

The mechanical engineering machine shop is equipped with 17 lathes varying from 4½ to 8-in. centres, a Holbrook all-gear head lathe, a vertical drilling machine, a radial drill, a slotting machine, two horizontal milling machines, a shaper, a capstan lathe, two cylindrical grinders, a surface grinder, a pillar drill, and one bench drill. In addition there are an electrical high-temperature muffle furnace, a muffle case hardening furnace, and a salt furnace.

This and all the other workshops at the college are extremely well lit by roof-lights and good local artificial light is provided on the tools by a 25-volt circuit. This low voltage is used for safety reasons and is generated by plant in the college electrical school.

A good friend of students interested in model engineering is Mr. D. S. Hattersley who, as mentioned above, is in charge of the machine shop. Although not a modeller himself, he has a warm spot for the hobby because he invariably finds that modelling enthusiasts are specially good students and, of course, in many cases have a lathe at home. Apart from being ready to give advice on such matters as the best method of machining model parts, Mr. Hattersley's interest takes a more practical form, for he will allow boys who are beyond their first year to make any parts required and will also supply them with certain materials. His assistance is always repaid when the student brings the finished model—generally a steam locomotive—to show him.

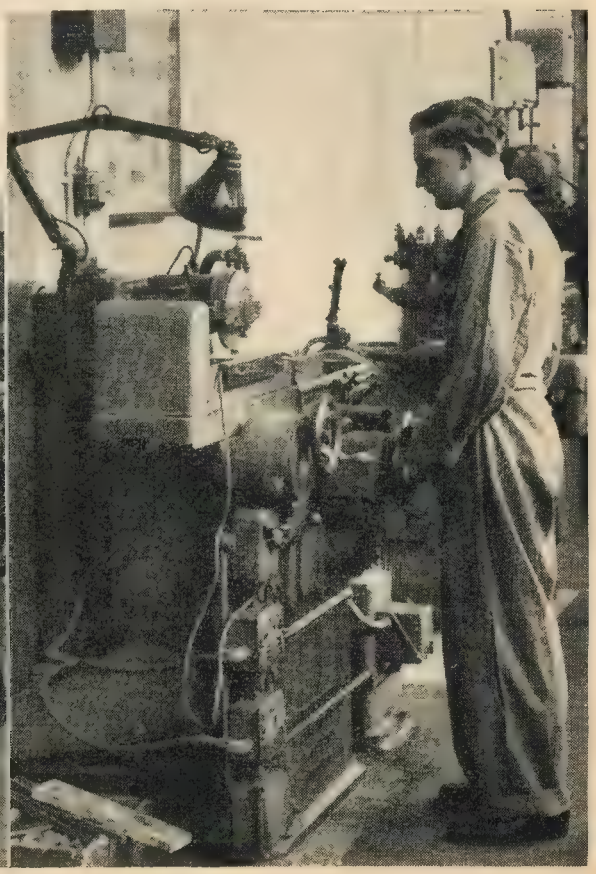
Adjacent to this shop is a 14-cubicle welding shop, where the equipment includes oxy-acetylene, electric, and gas welders, and also an argon cutter for aluminium. The sheet metal shop is equipped with rollers capable of turning cylinders from 3-in. diameter upwards, a folding machine capable of taking sheet metal $\frac{1}{16}$ in. thick by 2 in. wide, a foot guillotine with similar capacity, and a tinman's jenny, supported by the usual blow pipes and forging equipment. This shop is used by the secondary technical school students for simple machineshop practice exercises and is, therefore, also equipped with two small bench lathes.

The Students' Union has various affiliated clubs, including one for athletics. The college is very well provided with sports facilities, including ample grounds and a swimming pool. There is a full-time sports organiser on the staff. There is also a drama club, and an orchestra and choir, all of which make use of the very large assembly hall which has a fully-equipped stage.

During my visit to the college I discussed present industrial education trends in the area with Dr. Heathcoat, and he expressed his satisfaction over the growing realisation by local firms of the value of part-time day release. They are coming to recognise, he stated, that it furthers their own interest to allow the student to attend college at least one day per week, when the student's mind is far fresher that when he has to attend in the evening after a day's work.

Another good augury for the future, believes Dr. Heathcoat, is the increasing awareness of the careers open in industry, which is exemplified by the greater number of students coming forward from the grammar schools. Nevertheless, he feels that too many headmasters of grammar schools are still thinking too much in terms of "black-coated" openings for their pupils. He stressed that there are many openings in industry which provide opportunities for advancement and remuneration far beyond what the average black-coated job can offer. Only in this way can industry's demand for first-class entrants be met.

**Right: A student operates a surface grinder**



**Below: Operating an 18-in. Butler shaper**

# QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:
(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

**Lubricator for Steam Engine**

*I am building a small, but very detailed, model of a complete steam plant, comprising feed tank, pump, boiler and engine, mounted on a base, divided into boiler house and engine room.*

*I have taken considerable pains with scale details, and am rather at a loss to know how to lubricate the cylinder of the engine, while working, as in ¾-in. scale, I feel that a scale displacement lubricator would be of little use, while a working displacement lubricator would look a rather cumbersome appendage on the engine.*

*I am wondering if it would be possible to mount a working lubricator under the base (see sketch), and, if so, could it discharge upwards into the engine cylinder? Should this not be possible, I am considering trying to "disguise" the lubricator as a steam trap, in the main steam pipe. I should greatly appreciate any comments which you may kindly see fit to make.*

L.W.J. (Smethwick, 41).

A displacement lubricator will work quite satisfactorily at a low level such as you suggest, but there are other types of lubricators which could be employed, and which would possibly give more reliable results. You could, for instance, conceal a mechanical ratchet-type lubricator under the floor and operate it from the lower side of the eccentric strap, and a further possible alternative would be to use a hydrostatic lubricator, in which the oil is displaced by water admitted through a fine adjustment bleed valve from the feed pump delivery.

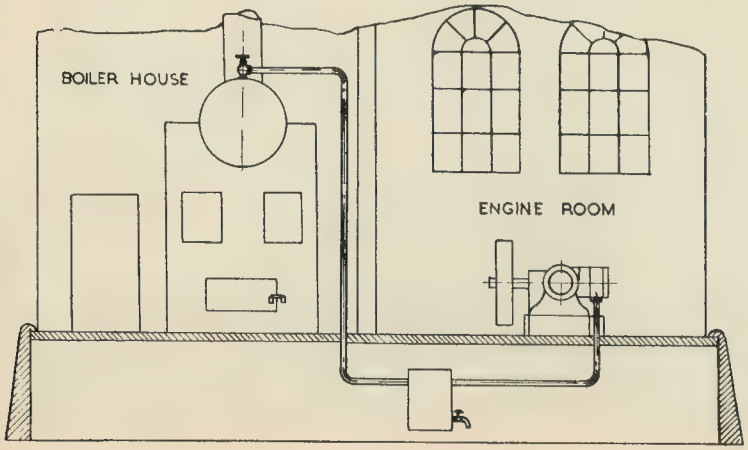
**Re-marking Indices**

*I have an old ornamental turning lathe which I am trying to restore to its original condition, and find that the markings on the indexed scales are becoming very indistinct. Is there a method of restoring the original divisions and numerals, and what is the best way to set about this rather tedious task?*

L.H.B. (Shipston-on-Stour).

It would appear that the most satisfactory method would be entirely re-engraving the markings, either by hand methods or a machine engraver. It would probably be necessary in such a case to machine the surface so as to remove the present markings entirely. We gather, however, that you do not wish to do this, owing to the desirability of preserving the machine as nearly as possible in its original state.

You might possibly be able to deepen the markings by etching, and to do this, the surface of the scales should be covered by an acid-resisting varnish, and the marks outlined by means of a scriber point, so that the acid applied to the surface could penetrate through the resistant varnish. This, of course, would require considerable skill to follow accurately the original lines, but it is the only method that we can suggest as an alternative to re-engraving.

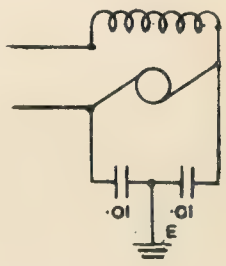



**Motor Suppressor**

*I have a small ⅛ h.p. electric motor working on 250 volts, a.c., and driving a small lathe, which is interfering with TV reception. Will you please let me know what value of condensers I shall need, and how to connect them, to act as a suppressor?*

W.McF. (Dumbarton).

We assume that your motor is one of the commutator type. With this class of motor, suppression is carried out by connecting suitable condensers between the respective brushes and earth. The condenser value will vary in accordance with the inductance value of the motor's windings. We suggest




that the following values may suit your motor: Two condensers of 0.01 m.f.d. connected in series, the mid point being the earth connection. The sketch will show how the condensers are connected to the motor. Messrs. A. F. Bulgin Ltd., Abbey Road, Barking, London, are specialists in the manufacture of this class of condenser. If you write to this firm, giving them full details of your motor, they will be able to supply the correct condenser to suit your motor.

**Fluorescent Lighting**

*I have recently purchased from one of your advertisers equipment for 80-watt, 200-volt fluorescent lighting, circuit for which is attached (not reproduced). I understand that the power factor can be improved by the insertion of a condenser, and would be grateful if you could advise me of the circuit amendment necessary, and the value of condenser to use.*

B.S.T. (Bournemouth).

Although a power factor corrector has no effect on the lamp so far as performance is concerned, it will improve the power factor of the current supplying it, and in so doing, under conditions, reduce the total power the lamp may consume at any time. With an individual lamp, there would not be much in this. Power factor correction would apply more where a large number of these lamps are being used in one place. As a matter of fact, the power factor condenser is often omitted as being considered unnecessary. The condenser value for an 80-watt lamp

(*Continued on page 168*)

# A Double-purpose Sine Bar

## By M. H.

TO lay out any angle accurately is to most of us a formidable task, and the necessary equipment for such an operation usually costs more than we care to pay. Angles seem to crop up at the most inopportune times. We may wish to machine such things as dovetail slides, angular ways, etc., or even bore holes to an accuracy of centre distance usually associated with jig-boring machines.

For such operations as these, a sine bar used in conjunction with a small attachment will be found to remove most of the headaches from the job.

A normal type of sine bar, if of sound manufacture, is quite simple to use because the centres of the rollers are accurate (see Fig. 1) and the height of the packing can be found directly from published tables. The method of use is as follows: Assuming that we are using a 5 in. sine bar and we wish to set up an angle of 30 deg., the height of the packing is found by multiplying the length of the sine bar centre distance by the sine of the angle to be found. In this example, referring to Fig. 2, the height would be:

$h = 5 \times sin\ 30\ deg. = 2.500\ in.$

The sine bar about to be described here differs slightly from the normal type, and has been designed for home workshop manufacture. Naturally, unless we are very skilled and have precision grinding machines available, it is difficult to match the precision of a commercially-made instrument, but this will cause no great inconvenience, apart from the fact that if the roller centre distance is not exactly 5.000 in., the simple calculation should be used instead of referring to standard sine bar tables.

The drawing, Fig. 3, shows the construction of the sine bar. The parts (details 1 and 2) are made from $\frac{3}{4}$ in. $\times$ $\frac{1}{2}$ in. ground key-steel, which is supplied ground to a tolerance of plus and minus 0.0005 in. Detail 1 is cut to a length of $5\frac{1}{2}$ in. and the dovetail machined. This may be done by milling on the lathe and finish scraping. The dovetail should be as parallel as possible with the sides, but a slight error will not matter too much, as the mating part is drilled and reamed on assembly. Detail 2 should be machined to a length of 4.250 in. to as close a limit as possible. The ends should also be dead square

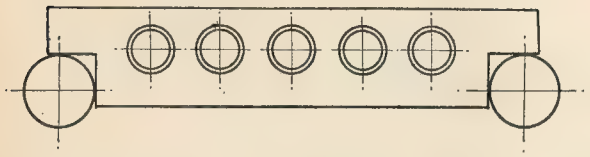
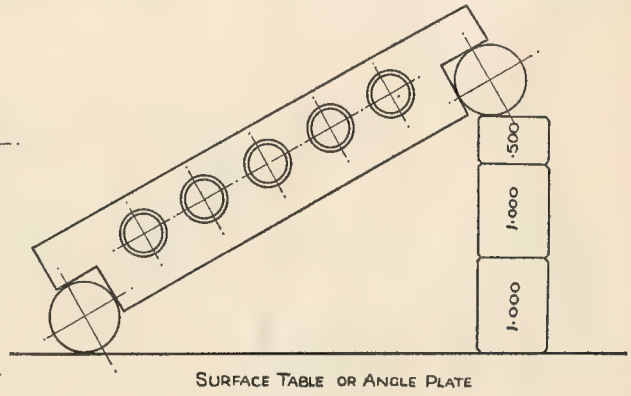


Fig. 1. A normal sine bar




Right: Fig. 2. Setting up a sine bar to an angle of 30° with gauge blocks or "slips"

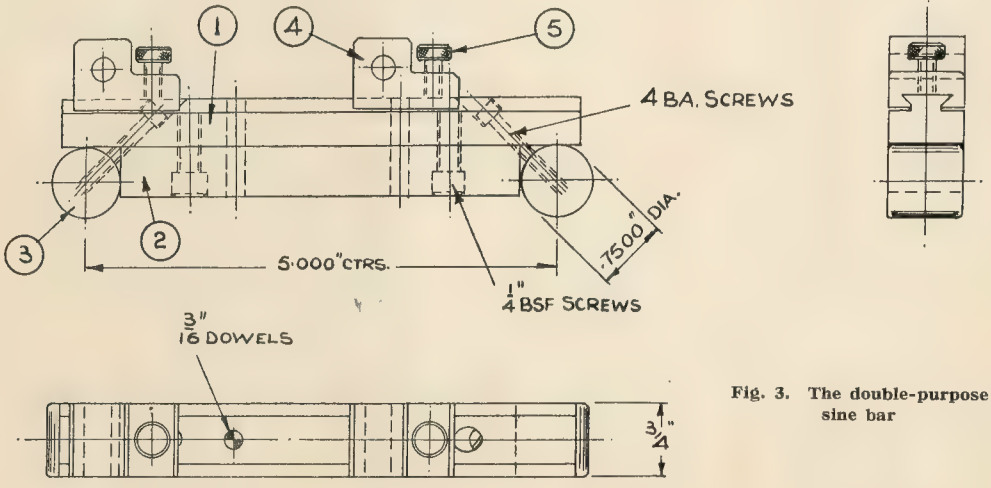



Fig. 3. The double-purpose sine bar

with the sides. A convenient method of doing this is by setting up the piece on an angle-plate attached to the lathe faceplate and facing off with a sharp tool. To ensure a flat surface on the ends, drill in a small dimple with a centre drill—this will prevent any small pip forming due to the tool being slightly off centre.

Screw together the details 1 and 2, and the drill and ream $\frac{3}{16}$ in. diameter for the two dowels. The roller fixing-holes should next be drilled and counterbored. Mark out and drill from the inside of the right-angle, and counterbore to suit the screw head. The rollers (detail 3) are made from $\frac{7}{8}$ in. diameter silver-steel, and should be turned to 0.750 in. diameter plus 0.0005 in. and lightly polished with a piece of worn-out emery cloth. Cut the two rollers to length and radius the ends with a fine file. After carefully marking-out and lightly centre-punching, drill and tap the 4-B.A. holes, and fix to the previously made body by steel head-screws.

We now have the basic sine bar, and can proceed with the attachment to be used for accurate hole spacing. This consists of the two sliding blocks (detail 4) and should be made from a piece of $\frac{3}{4}$ in. square mild-steel sufficiently large enough for them both. Mill out the dovetail slot first, leaving it a little on the tight side for final fitting, and then cut out the lugs for the clamping-screws. Drill and tap 2 B.A., then countersink the first thread away from the bottom to prevent any burrs binding on the body. The blocks can now be sawn apart and generally cleaned up to a polished finish. At this stage, the final fitting of the dovetail can be done, to give a good sliding fit on the sine bar body.

The clamping-screws (detail 5) are made from hard brass, and are screwed 2 B.A. and have their heads fine knurled. As an extra, small tommy bar holes can be drilled in, if required, but these should not be necessary if the fit of the dovetail is reasonable.

The final operation is to drill and ream the $\frac{1}{4}$ in. diameter holes. Mount one of the blocks somewhere near the centre of the sine bar, and mark out the position of the hole and lightly centre-punch. The sine bar should then be set up on the faceplate, with the centre-punch mark running true, and the hole then drilled and reamed. Without disturbing the sine bar, remove the block and replace it with the other one, clamp it with its own screw, and make the hole as before. The final burrs can now be removed, and the instrument is ready for use.

With reasonable care, no trouble will be experienced with the sine bar, but it should be borne in mind that nothing has been hardened, and inaccuracies will creep in if the rollers are bruised.

In tool rooms, where sine bars are mostly used, the packing would be ground and lapped gauge blocks. A good set of gauge blocks or "slips" will give any combination of size within their range in increments of 0.0001 in. In our case, where no such refinement is likely, the packing can be $\frac{1}{2}$ in. diameter mild-steel bar faced to the length required and dimpled on each end to prevent the pip forming. It is a good idea to make an initial set of these in standard sizes from 0.1 in. to 1 in. and rising in increments of 0.1000 in.; any odd sizes could then be turned up as they were required, and so gradually build up the set.

# Queries and Replies

*(Continued from page 166)*

would be 8 mfd. at a working voltage of approximately 275. This condenser is connected across the incoming supply of the lamp, that is, across the main terminals. Sometimes there is a smaller condenser fitted across the make-and-break of the starting switch; this condenser is for the purpose of suppression from a radio interference point of view.

**Working Ignition System from Mains**

*I have completed a 30 c.c. stationary petrol engine, and wish to obtain current for coil ignition from the mains, which are 230-250 volts a.c. I have a Lucas 6-volt motor-cycle coil and condenser. Could you advise me of the necessary additional equipment I shall need.*

H.P. (Wallsend-on-Tyne).

We suggest that the most suitable arrangement would be to use a transformer and rectifier to give the required d.c. output, namely 6 volts, to operate the coil.

In view of the fact that most coil systems take a fairly heavy starting current, the output capacity in terms of current must be adequate, though very much less current is required when the engine is running normally. We may mention that we have successfully used a transformer without a rectifier for operating coil ignition, though this is theoretically all wrong. In this case, of course, the cost of the rectifier is eliminated, but we should recommend that an experiment should be made to see whether this is satisfactory before deciding definitely on this arrangement.

**Electric Razor**

*I wish to carry out some experimental work with an electric razor. I would be pleased if you could let me know the h.p. and speed of revolutions of the type with rotating blades.*

*I should also like to know if a flexible cable drive would be suitable for transmitting the power required to drive an electric razor.*

C.R.Y. (Kempston Hardwick).

We have no exact data on this particular subject, and we suggest that it must be regarded entirely as an experimental venture.

The h.p. of electric motors used in these razors is extremely small, but they are designed to run at extremely high speeds, up to 6,000 r.p.m. or more. The most serious practical problem in the construction of an electric razor is the construction of the shearing blades, which are made with a very large number of cutting edges, and the outer stationary blade must be very thin indeed to enable the rotating blade to operate as close to the skin as possible, to obtain a clean shave.

We have never seen a flexible cable drive used for transmitting the motive power to an electric razor, and while this would be practicable, it would undoubtedly absorb a fairly considerable amount of power, and necessitate the use of a larger motor; but if you propose to experiment with this, we suggest that the type of flexible cable used in dental handsets would be most suitable.

In the case of self-contained razors, we know of no commercially-made motor sufficiently small to enclose a casing of normally compact size. The h.p. required would probably be not more than 1/200 h.p.

**Welding Plant**

*I wish to construct an electric arc welding plant for my home workshop, using either a generator driven by an i.c. engine or a transformer working off the mains. Would you please tell me which you consider the most suitable, and the type of generator or transformer which would be required?*

P.B. (Reading).

Of the two, the transformer method would be likely to be the cheaper. We regret that we are unable to suggest a size of transformer, because you do not give us any idea as to the class of work you expect to do. If we may have this information, and the thickness of metal to be welded, we can suggest a suitable transformer and regulator for such a plant.

# FLYWHEELS AND PULLEYS

## By Andrew Smith, A.M.I.E.D.

THE interest shown in these columns on the subject of flywheels and pulleys, particularly with reference to the shaped arms of gas engine flywheels, prompts the writer to submit these few notes on this topic.

With reference, first to the proportions of a pulley, especially the rim, they are often seen in models, particularly of the mill engine variety, to be much too

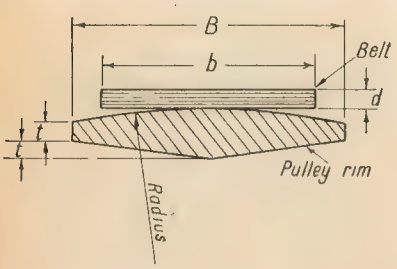



Fig. 1

thick. The pulley rim should be a little wider than the belt it is intended to carry. Let $B$, Fig. 1, equal the width of the rim, and $b$ the width of the belt. Then :

$$B = \frac{9}{8}(b + 0.4)$$

Where the above formula gives an awkward size, the nearest reasonable size should be taken. For example, in full-size practice, when $b$ is 4 in., $B$ will be 4.95 in., thus 5 in. would be taken. Similarly, when $b$ is 5 in., $B$ will be 6.08 in., and hence 6 in. will be taken as the pulley width.

The form of the rim in section is shown in Fig. 1. At the edge the thickness should be:

$$t = 0.7d + 0.005\,D$$

where $D$ is the diameter of the pulley and $d$ the thickness of the belt.

The rim of the pulley is rounded to a radius of from $6B$ to $12B$. In very wide pulleys the middle part is left cylindrical. The diameter of the smaller

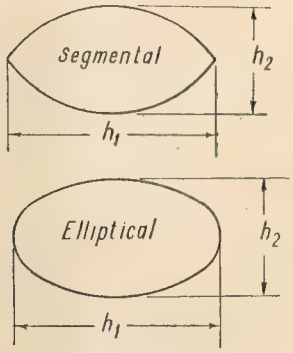



Fig. 2

of two pulleys should not be less than 24 times the belt thickness in any case, and generally not less than 35 times the belt thickness.

Pulleys run at high speeds are liable to burst from the tension in the rim. Let $w$ be the weight of a bar 1 in. square in section and 12 in. long. Then the weight of one foot length of a pulley rim of section $x$ sq. in is $wx$ lb. If $v$ is the velocity of the rim in feet per second, and $r$ the radius in feet of the pulley rim, then the centrifugal force of one foot length of rim is $\frac{wxv^2}{gr}$. Consider the pulley to be divided by a diametral plane, then the resultant centrifugal force of each half of the pulley rim, acting normally to the dividing plane, is

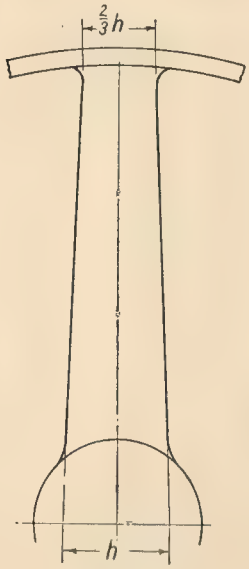



Fig. 3

$$\frac{wxv^2}{gr} \times 2r = \frac{2wxv^2}{g}.$$

This force is balanced by the tensions on the two sections of the rim by the diametral plane. Consequently the whole tension in the rim is $\frac{wvx^2}{g}$, and the intensity of the stress is $\frac{wv^2}{g}$ lb. per sq. in.

(*Continued on page* 171)

Fig. 4

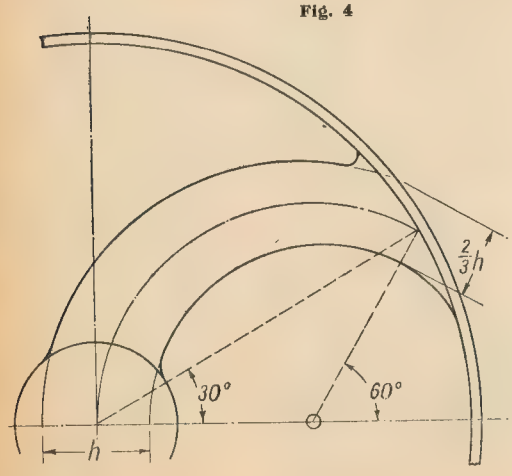
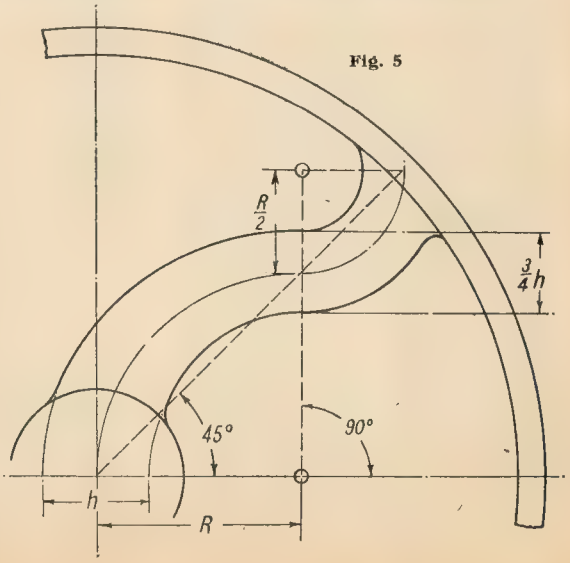



Fig. 5



# READERS' LETTERS

**Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.**

### MODEL POWER BOAT PROPULSION

DEAR SIR,—In reply to Mr. I. P. Millar (in THE MODEL ENGINEER, December 16th last), the burden of his interesting and instructive letter is undoubtedly condensed into a remark he made at the end of it, namely, "why not be precise ?"

Why not, indeed, if one wishes to be? But the article in question was obviously not so intended, but rather to be a friendly "natter" around the subject, which, in my opinion could only appear "comic" to one with a specialised sense of humour.

I am not a marine engineer, but a humble modeller who likes to discuss his findings and theories (however comic they appear), and not be too pedantic by analysing and particularising every generalisation.

Anyway, it is good to know that the article was of sufficient interest if only to arouse adverse criticism.

Now perhaps Mr. Millar, with his greater experience in marine engineering, will contribute further information, if only to substantiate his claims to precision and show just how, in his opinion, it should be done.

Yours faithfully,
St. Albans. R. H. MAPPLEBECK.

### SWITCH MODIFICATION

DEAR SIR,—Referring to the article by "Duplex" (Jan. 6th), may I offer the additional information that there is a very useful 3-pin plug and socket on the market which would serve as an alternative to the arrangement shown in Fig. 6. It has its pins arranged in a sunk recess mounted on a flange and the plug is a moulding carrying three sockets which are fully protected; it is keyed to assure correct engagement and arranged for ordinary 3-core flex.

These plugs are sold by radio shops for three or four shillings complete and bear the name "Bulgin." They have no switch but they are useful where switches are not wanted or where there is one on the wall anyway.

Although the domestic iron socket (illustrated in Fig. 2) has no switch, there is a similar fitting supplied for vacuum cleaners which has a bar switch ; this would appeal where it has been found expedient to build the two pins and earth into the appliance like the arrangement on the electric iron.

Both the fittings mentioned are good for 5 amps.

Yours faithfully,
Harrow. L. J. LAWRANCE.

### THE "DUPLEX" ENGRAVING MACHINE

DEAR SIR,—Having made the above machine and put it to serious work (which is turning out really first-class), I have run into two troubles. The method of overcoming them may be of interest to other builders of this excellent little machine.

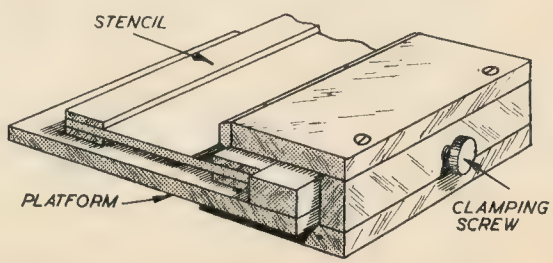
(1) *The Belt Drive.*—Plastic belt got warm and stretched after being in use for more than a few minutes. Leather belting was better, but after about one hour's continuous run it would pull its joints. Finally I have found a Singer Sewing Machine V-belt to give perfect results, and can strongly recommend it to other users. These belts are a little shorter than the "Duplex" machine will adjust to, but it is a fairly simple matter to alter the motor mounting, and is well worth the trouble.

(2) *The Stencil Clamp.*—Perhaps this should be called a trial rather than trouble. When engraving a lot of lettering, a loose clamp can be quite trying, and also takes up more time than it should to set. To improve matters I have made a clamp as sketch, and have done away with the spring-loaded plate. This clamp is quick and positive and allows for the different width of stencil edging. (My $\frac{1}{2}$ in. upper case, lower case and figure stencils are all of different edges.)

Now, I should like some help; would Messrs. "Duplex" please give some drawings or schematic sketches of a way the engraving machine can be adapted to engrave silver cups and other cylindrical articles ?

I presume this sort of work can be carried out on this type of machine by moving the work on its own axis, and keeping the master plate or stencil in the same position for each letter engraved.

*But*, how is the work turned the correct amount for each letter, as all letters are not of equal width, also how are the various size of cups held in the machine ?



STENCIL CLAMP FOR THE "DUPLEX" ENGRAVER

Trusting Messrs. "Duplex" will be able to find time to give at least a brief outline on the adaptation. Thanking them for the design of such an efficient little machine.

Yours faithfully,
Winslow. W. G. CHOWLES, C.M.B.H.I.

### ELECTRO-MAGNETS

DEAR SIR,—Referring to the query by T.C.D. of Glasgow, W.2, in the issue of THE MODEL ENGINEER, dated January 13th, concerning an electro-magnet for a clock, I can offer from experience the following data.

The cores may be made from free-cutting steel $\frac{1}{4}$ in. diameter, and having a $\frac{5}{16}$ in. diameter head, say $\frac{1}{8}$ in. wide. These should be approximately $2\frac{1}{4}$ in. long, and may be pressed into a mild-steel yoke. All the steel may be annealed by leaving overnight in a fire. The winding may consist of approximately $\frac{1}{4}$ lb. 24 s.w.g. enamelled copper wire wound on each pole, and connected in series to give N. and S. poles. This winding will make each coil approximately 1 in. diameter, and a $4\frac{1}{2}$-volt battery of fairly large capacity will be sufficient to operate the clock satisfactorily.

Yours faithfully,
Newark. A. G. TOMBLIN.

### MUSEUM MODELS

DEAR SIR,—In THE MODEL ENGINEER for January 6th, the cover of which shows a picture of a Tangye Salvage Engine by Messrs. Kent and Tapper, your note referring to their models states: ". . . many of them have been adopted by industrial museums as authentic illustrations of the history of engineering development."

It may be of interest to your readers to know that all the engines which are at present on view to the public, have been lent to this museum (City Museum and Art Gallery, Department of Science and Industry, Newhall Street, Birmingham, 3) by Messrs Kent and Tapper as a long term loan. We are grateful to these gentlemen for their generous help, and we do know that many people visit the museum on purpose to see the Kent and Tapper collection.

Yours faithfully,
N. W. BERTENSHAW.
Birmingham.

### A RAILWAYMAN ANSWERS

DEAR SIR,— Being a reader of THE MODEL ENGINEER, and also a footplateman, I am very often amused by the so-called super engine of Mr. Hockings, also the replies and letters of various people to this proposed "engine of the future."

Now we have got the B.R. Standards on this Region (G.W.R., I prefer to call it) and, believe me, I know what we all think of them !

Here we have a massive engine that does not seem able to do the work of a "Castle" or "King" without being in the shops for a week or two after trying to do it. Why not have taken a "King" and improve on it (or can they ?). Still, that is not what I am coming to.

In THE MODEL ENGINEER for January 6th, I saw a letter by a Mr. Peter Waller of Harrogate, who seems to know more about railway work and its workers than they do themselves. In one paragraph, he suggests that the platelayers and signalmen are immeasurably the more capable, skilful and intellectual than the locomotive driver, and, I presume, the fireman is included, too.

As regards the signalmen, these men are covered in their boxes by almost fool-proof instruments; unless they happen to be forgetful, there can be no accidents, or at least not many. Once they have learnt the bell-codes, boxes, rules, regulations, etc., there is not a lot in it. I myself took a signalling examination last year, and passed. I am taking another this year. I do this because it exercises my knowledge of railway work.

Now, a signalman cannot do my job in his spare time, or even learn it; so I think your paragraph is somewhat uncalled for, Mr. Waller. I would dearly like to see your expressions on the footplate of an express locomotive doing 75 or 85 m.p.h. in the night, passing dozens of red lights in front of you, wondering, perhaps, if one of them is a tail-light of a train in front, and then to flash by them. No, sir, you don't know railway work, so don't try to mislead others !

Yours faithfully,

Decoy, Devon. E. SIMS.

### BOILING POINT OF MERCURY UNDER PRESSURE

DEAR SIR,—May I express my sincere thanks to you for publishing my query, and to all those gentlemen who have gone to so much trouble to provide me with the desired information.

They have between them provided me with all the information I needed and a good deal besides which is likely to be of future use, and which I have already filed for reference. It is most refreshing to find that there are so many people who do *not* regard theory and science as inherently "comic." Once again my grateful thanks to all concerned.

Yours faithfully,

Rustington. K. N. HARRIS.

### INFORMATION WANTED

DEAR SIR,—About 1927, a reorganisation of the power layout took place in our works, and two Willans-Robinson vertical, twin, steam engines were put in to supply power during the change over. They cost, if my memory serves me right, £20 each; of course, second-hand. They shared the same bed with dynamos made by Castle, the output of each engine being about 45 h.p., at 120 p.s.i.

In 1938, one of these sets was scrapped, and the other about to be when we decided to keep it "just in case." The dynamo wasn't too reliable as regards the brush gear, so we arranged a drive to a compound generator by means of "V" belts.

The remaining engine has not turned round since 1938. Recently we decided to connect up the steam pipes to this set; when this was done, and the steam valve opened, she started like a bird, and went up to a steady 450 r.p.m. as sweet as could be.

Could any reader give the writer any information on this e ngine, the number of which is 3100. Particularly interesting would be the date of make, and any details of the "works." The writer helped to erect the sets as a very small boy just starting work, but cannot remember many details.

Yours faithfully,

Littleborough. J. E. CLEGG.

### FOOT-LATHE POWER

DEAR SIR,—I see in "Readers' Letters" that "Novice" quotes the figure of 1/3 h.p. as being exceeded on occasion with a substantial foot lathe; now, in case anyone doubts such to be possible, there is a very interesting table, showing the values of manual power, in *Mill Gearing* by Thomas Box (London: Spon, 1882). This is Table 4, on page 12 of that work, where he states that, 0.236 h.p., a little more than ¼ h.p., may be maintained with a tread wheel, for a duration of two hours. So that for a burst of just a few minutes, no doubt 0.33 (1/3) h.p. could be reached; more easily so with a lathe where the bearings are well-oiled, and, as in the case of a 5-in. foot lathe, there will be two flywheels, both very heavy. It is for such exceptional conditions that a machine must be designed, and certainly that is why Drummonds made the bed of their "M" lathe so stiff; let every amateur who has a lathe with a lighter type of bed, beware of a "dig-in," it would be very interesting to fix some gauge or indicator to a foot-lathe bed, and then (using, of course, an old machine for the trial) causing a seize-up or dig-in deliberately. Under such a condition, I believe it could be plainly shown, that a lathe bed can actually be twisted by mere foot-effort.

Again, the size of a mandrel must be governed by the work for which a lathe is wanted; if many jobs involving "interrupted cuts" are to be done, a one-inch mandrel diameter cannot be said to be large enough for a 3½-in. lathe. It is all very well to have a very strong back gear, but if we put this together with a small mandrel, we have an enormous stress on the screw-thread of the mandrel nose, and, therefore, this ought to be made amply large. On the "Drummonds," of 3½ in. and 4 in., the mandrel-noses are, I believe, too small; to have made them 1¼ in. on 1⅜ in. would have been a vast improvement to these celebrated tools. And even in these sizes, one has to consider that some people have to do serious engineering work with such small lathes, while the amateur wants the characteristics of the instrument-maker's lathe at the same time, and it is a very difficult matter really to combine their respective functions. But to sum up, surely one wants the largest mandrel, and a thin oil; never the other way round.

Yours faithfully,

London, N.W.7. H. H. NICHOLLS.

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# FLYWHEELS AND PULLEYS

(*Continued from page* 169)

The arms of pulleys and flywheels are of elliptical or segmental section, as shown in Fig. 2. The latter form of section looks lighter than the elliptical section. For a segmental arm the thickness $h_2 = \frac{1}{2}h_1$. For an elliptical arm the thickness $h_2 = 0.4h_1$. The arms may be either straight or curved. The curved arms are stated to be less liable to fracture from contraction in cooling, but in all other respects the straight arms are preferable, being lighter and stronger. The section of the arms is diminished from the nave to the rim, so that if we put $h_1$, $h_2$ for the breadth and thickness of the arm, supposed produced to the centre of the shaft, the breadth and thickness at the rim will be 2/3 $h_1$ and 2/3 $h_2$, or $\frac{3}{4}h_1$ and $\frac{3}{4}h_2$.

Fig. 3 shows an ordinary straight arm, Fig. 4 a curved arm, and Fig. 5 an S-shaped or doubly curved arm. The figures indicate sufficiently the way in which the centre-line of the arm is drawn. Let $R$ be the radius of the pulley or wheel, measured to the inside of the rim. Then in Fig. 4, $r = 0.577$ R, and in Fig. 5, $r_1 = 0.471$R, and $r_2 = 0.236R$.

Let $n$ be the number of arms, $B$ the breadth, and $D$ the diameter of the rim. Then,

$$n = 3 + \frac{BD}{150}$$

the nearest whole number being taken.

The number of arms is really arbitrary, and may be altered if necessary.

# WITH THE CLUBS

### The Rugby Model Engineering Society

We intend to hold an exhibition of models and handicrafts at the Church House, Church Street, Rugby, opening on Saturday, April 16th, until Saturday, April 23rd, 1955. Exhibits will be by local enthusiasts as far as possible.

It is hopea that the 5-in. gauge portable track will be available for rides.

All who are interested in model work are welcome at our weekly meetings on Fridays at 7.30 p.m. Headquarters: Kimberley Road.

Hon. Secretary: W. R. NEWBOLD, 17, Wood Street, Rugby.

### Southend Model Railway and Engineering Circle

At their A.G.M., the club re-elected all their 1954 season officers for a further year.

Meeting nights have been changed to Wednesday. Work still continues on the live steam track, the "OO" layout, as well as the workshop benches.

New members are always welcome at the headquarters.

Hon. Secretary: J. DAWSON, 10, Boston Avenue, Southend, Essex.

### Ickenham & District S.M.E.

In spite of the recent bad weather, work has continued on the building of own permanent headquarters. All the exterior work is now completed.

Formal meetings have been held to agree to plans for the "OO"-gauge layout, which is being built around the interior perimenter of the new headquarters, and for the erection of a permanent multi-gauge track for our members' larger locomotives.

Mr. Bolley has nearly completed his 3½-in. gauge "Maisie." He carried out a steam test on a temporary testing bed, and the locomotive performed perfectly. The local press has taken a good deal of interest in this particular locomotive, and there may be a heavy demand this summer for this locomotive to be run at local functions.

New members will be welcomed any Friday evening at our headquarters site situated behind the "Coach and Horses," by Ickenham Pump.

Hon. Secretary: MR. L. A. GROSS, 16, Thurlstone Road, Ruislip, Middlesex.

### The Manchester S.M.E.E.

A visit to the Derby Locomotive Works has been arranged for Sunday, March 20th, 1955. Will all members intending to participate in this visit please contact the secretary before February 19th in order that transport can be booked?

Hon. Secretary: P. SYMOND, 33, Grangethorpe Drive, Burnage, Manchester, 19.

### Sutton Coldfield and North Birmingham M.E.S.

The programme until May is as follows:—

February 22nd "Television," C. W. Winkley (member). March 8th, Open Forum; 22nd, Irish Narrow Gauge Railways, O. H. Prossor (member). April 5th, "Dudley Priestley" Cup Competition; 19th, Annual General Meeting. May 3rd, Open Night (exhibition discussion).

All meetings 7.30 for 8.0 at the "Swan," High Street, Erdington. Our exhibition this year will take place in the first week of October at the Church House, High Street, Erdington.

Hon. Secretary: J. REVILL, 75, Churchill Road, Bordesley Green, Birmingham, 9.

### City of Leeds S.M.E.E.

At the A.G.M. the following officials were elected: President, Mr. F. Cook; vice-president, Mr. H. Donald; chairman, Mr. J. H. Hainsworth; secretary, Mr. E. Mann; Treasurer, Mr. T. C. Laycock.

The president reminded members that the society was now in its 20th year, and that as a founder-member he was glad to see the usual friendly spirit in the society. Once again, he emphasised the desirability of enrolling more members, particularly in view of the work which would have to be done on the permanent track now under consideration.

The chairman asked for a determined effort on the part of all members in the near future when we should be starting work on the new track. The site, now chosen, was in very pleasant surroundings in Temple Newsam Park, and he looked forward with confidence to the time when we should be running our locomotives on our own track.

Future programme: Tuesday, February 15th, Jumble Sale. Tuesday, March 8th, Talk by Mr. A. A. Chubb, A.M.I.E.E., entitled "Perpetual Motion." Tuesday, March 22nd, Film Show.

Visitors and prospective members are welcome at the above meetings which will be held at Salem Chapel, Hunslet Road, Leeds, 7.15 p.m.

Hon. Secretary: E. MANN, 162, Town Street, Armley, Leeds, 12.

### The West Hartlepool S.M.E.

The society is still going strong, and with a gratifying increase in membership.

The various sections now cater for: live steam, "OO"-gauge, marine, model aero, and electronics, which also covers radio-control.

The construction of the society's locomotive track can always be relied upon to provide a topic of conversation at any of our meetings, and with this project in mind, six locomotives of either 3½ in. or 5-in. gauge are in various stages of construction. Other items of interest are: The "OO"-gauge section is setting up a society layout; the marine section, new ventures or modifications "on the stocks," as also the aero section, while the electronics department always has something fresh to put before us.

Our meetings are always held on the second Wednesday in the month, at 1a Hope Street, West Hartlepool. at 7.30 p.m.

Hon. Secretary: A. C. LAMB, 9, Brus Corner, West View, Hartlepool, Co. Durham.

### Southend Model Powerboat Club

At the annual general meeting, it was decided that the monthly meetings would continue to be held on the first Friday of each month at H.Q.

The officers elected for 1955 are: Chairman, C. J. Vann; secretary, J. L. Harrison; asst. secretary, C. R. Smith; treasurer, H. Brown; publicity, B. S. H. Smith; race officer, W. Hayward; chief marshall, J. Starkey.

Hon Secretary: J. L. HARRISON, 10, Broadclyst Gardens, Thorpe Bay, Essex.

### Staines S.M.E. & C.

The programme for the next three months is as follows:—

February 23rd—"Modern Resin Adhesives," explained and demonstrated by Mr. Melton.

March 9th.—"Quiz Night."

March 23rd.—Mr. Hodges will tell how to check and renovate machine tools.

April 6th.—London Transport provide this evening's entertainment, with the aid of lantern slides.

April 20th.—Mr. Hotchkiss will explain "The Mechanics of Deception."

A warm welcome awaits any fellow M.E. residing in our area. Meetings at the Phoenix Hotel, Church Street, Staines, 7.45 p.m.

### The Junior Institution of Engineers

Friday, February 11th, at 7.0 p.m. Pepys House, 14, Rochester Row, S.W.1. Ordinary meeting: Paper—"Underground Water," by K. G. Benham, A.M.I.C.E., F.G.S.

Sheffield and District Section. Monday, February 14th, at 7.30 p.m. at Livesey Clegg House (opposite Union Street Cinema), Sheffield. Ordinary meeting. Paper: "Blast Furnace Plant and Operational Problems," by E. A. Cotterill (blast furnaces superintendent, Park Gate Iron & Steel Co.), and "Electrical Equipment and Services for the Blast Furnace Plant at the Park Gate Iron and Steel Works," by H. Demaine (assistant electrical engineer, Park Gate Iron & Steel Co.).

Friday, February 18th, at 7.0 p.m. Pepys House, 14, Rochester Row, S.W.1. Informal meeting: Paper—"The Atom," by S. A. McAuliffe (member).

Friday, February 25th, at 7.0 p.m. Pepys House, 14, Rochester Row, S.W.1. Informal meeting: Paper—"Some Stages in the Refining of Crude Oil," by H. W. D. Hughes (student).

Friday, March 4th, at 7.0 p.m. Pepys House, 14, Rochester Row, S.W.1. Film evening.

Friday, March 11th, at 7.0 p.m. Pepys House, 14, Rochester Row, S.W.1. Ordinary meeting: Paper—"The Rolling of Structural Sections," by W. H. Bailey (member).

Sheffield and District Section. Monday, March 14th, at 7.30 p.m. at Livesey Clegg House (opposite Union Street Cinema), Sheffield. Ordinary meeting: Paper—"The Reconstruction of a Soaking Pit Building," by K. H. Best, B.Eng., A.M.I.C.E. (Husband & Co. Ltd.).

### Stockport & District S.M.E.

Through the good offices of our member, Mr. D. C. Gerrard, we have been so fortunate as to arrange a visit of Mr. D. H. Chaddock, who will speak on, "Model Steam and Gas Turbines."

Mr. Chaddock will need no introduction to any model engineer, and we can be sure of an extremely interesting and instructive evening. The date of the visit is Friday, February 18th and the place, The Foresters Hall, Churchgate, Stockport. The meeting will commence at 7.30 p.m., and visitors are cordially invited to attend.

Hon. Secretary: D. MAPP, 163, Mauldeth Road, Withington, Manchester, 20.

## Next Week . . .

**"A LOCOMOTIVE LULLABY"**

Under this most unusual heading a reader tells the story of the construction of a "Juliet," the difficulties encountered and how they were overcome. It is quite entertaining, but the result is a very neat little engine.

**"NETTA"**

This time, the 1¾-in. gauge engine is featured again, with full drawings and all possible information for building the boiler.

**TWIN-SCREW MARINE ENGINE**

A steam engine of unique design, specially intended to drive the twin propellers of a model destroyer, described by Mr. H. W. R. Gosden.

**POWER IN THE KITCHEN**

Details of a practical and tastefully designed motor-driven food mixer.

**MACHINE TOOL MODELS**

Inspired by the models of factory and industrial plant seen in the "M.E." Exhibition and the Science Museum, Mr. F. Surgey explains how he modelled a number of old-time machine tools.


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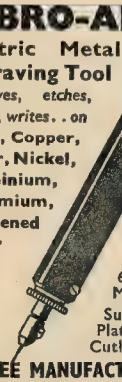

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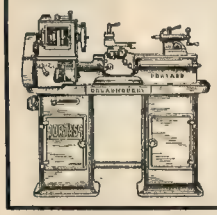

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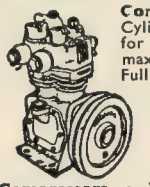

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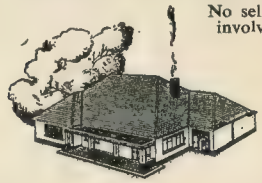

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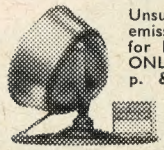

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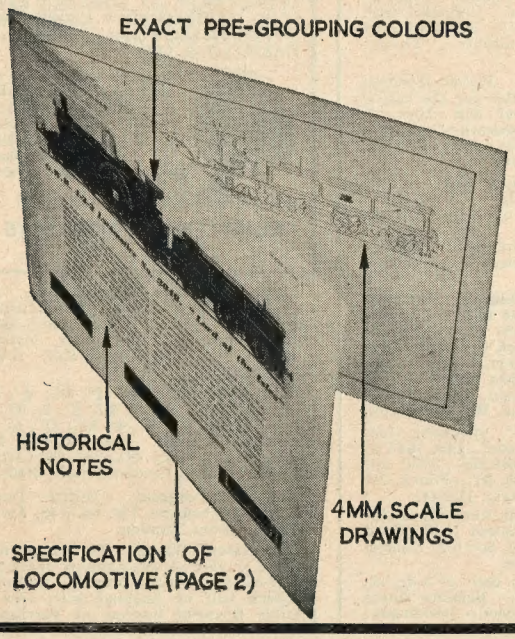


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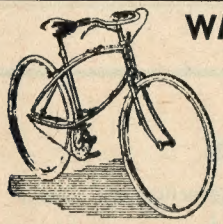

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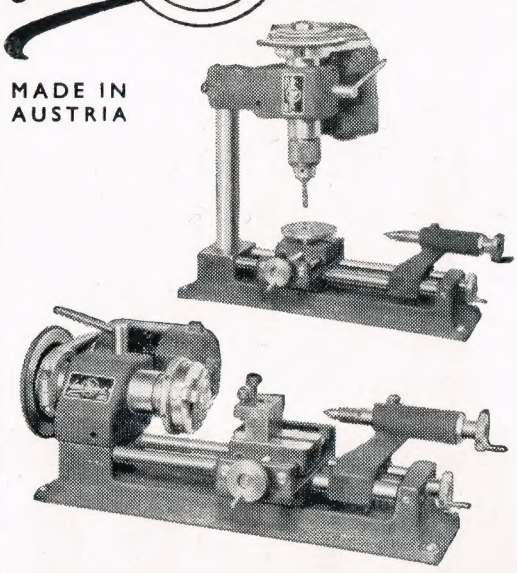

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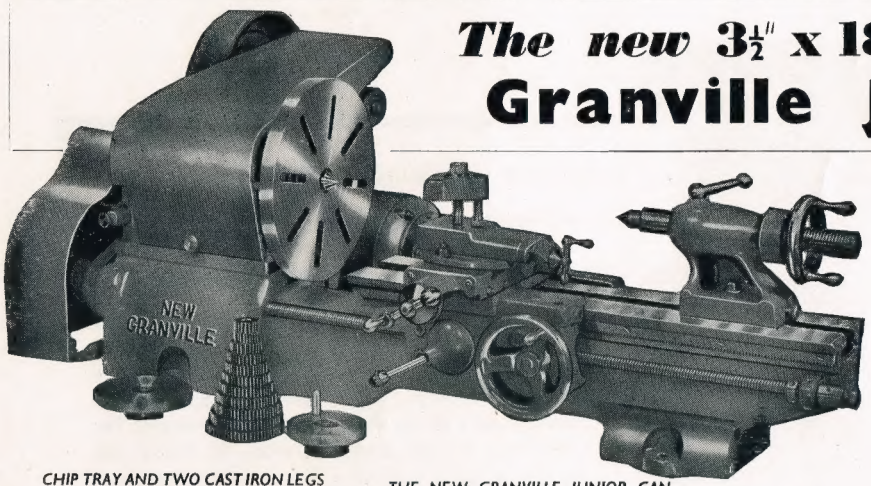


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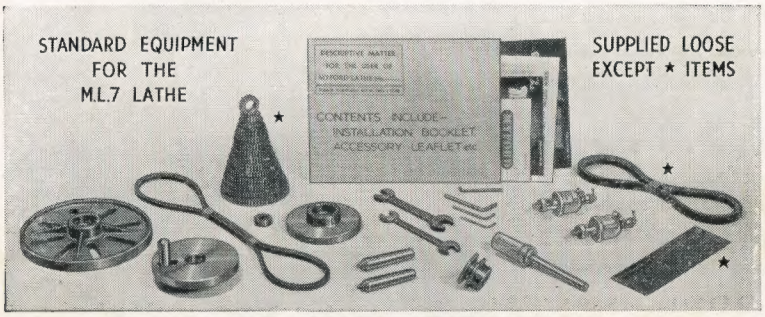


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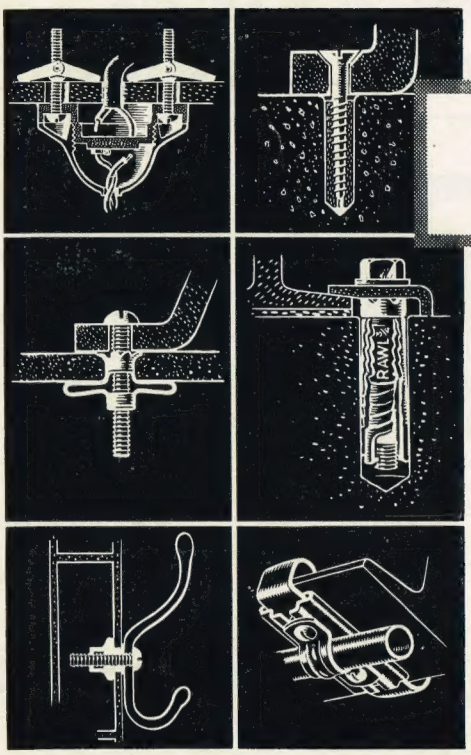

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